U.S. ARMY SIGNAL CENTER AND FORT GORDON
Fort Gordon, Georgia 30905-5180

LESSON PLAN

TITLE: AN/TYC-39A Space Division Subscriber Functional Analysis

LEARNING OBJECTIVE:

Action: In Part One, the students will install space division subscribers by determining the correct signal path, populating, strapping, and aligning modems and patching. In Part Two, the students will answer questions about space division subscriber functional analysis.

Conditions: The student will be given an AN/TYC-39A, TM 11-5805-790-12-6, and Practical Exercise, 150-74G10/F01-LP01-PE.

Standard: In Part One, acceptable performance is achieved when the student determines the correct signal path and installs subscribers by populating modems, line terminating units (LTUs), and loop key generators (LKGs); also by ensuring these are correctly strapped, aligned, and patched as needed. The student will have 90 minutes to perform these tasks. In Part Two, acceptable performance is achieved when the student correctly answers 14 out of 20 questions in 1 hour.

SAFETY CONSIDERATIONS: This lesson has safety hazards which may cause electrical shock or physical injury. Make sure students remove all jewelry and metal objects such as watches, rings, bracelets, and identification tags.

RISK

APPROVAL DATE: 15 DEC 97
DEVELOPER: SFC CARTAGENA
DIV. CHIEF: Jack P. Rondon

ASSESSMENT: LOW.

RESOURCE NEEDS/ REFERENCES: AN/TYC-39A, TM 11-5805-790-12-6, Oscilloscope, Digital Multimeter, Jewelers Screwdrivers, Overhead Projector, and Slides 1-8.

METHODS OF INSTRUCTION: Conference, Practical Exercise

TIME: 18 Hours

NOTES TO INSTRUCTOR:

1. Ensure that all training resources are available.

2. Ensure that all safety procedures and practices are followed.

3. Ensure that equipment is operational before and after class.

INTRODUCTION:

Elapsed Time

1. In the last lesson, you learned the functional analysis of the communications equipment support group (CESG) and about the components contained within.

2. This lesson will teach you the analog signal patch and how to prepare the CESG components for space division subscriber installation. You will be taught how to strap and align modems to meet specific requirements for installing an analog circuit. At the end of this lesson, you will be required to answer 14 out of 20 written questions pertaining to space division subscriber installation within 1 hour.

3. Let us begin our study by following the dedicated analog signal path from its entry in signal entry panel (SEP) to its entry into the LTU.

3M

BODY:

1. Analog signal path.

NOTE: Refer to the Student guide page. This diagram illustrates the path that the analog signal flow will follow.

a. Analog data enters the message switch on dedicated analog loops or trunks.

NOTE: Show Slide 1 and explain.

b. These loops or trunks enter the black SEP through assigned pairs on a 26-pair cable.

c. This signal follows a dedicated path through the black P/P.

d. Interface occurs with the loop modems (Types I, II, and diphase).

e. The modem converts the signal to a digital baseband signal.

f. The digital baseband signal, which is encrypted, passes through the black LKG P/P.

g. From the black P/P the signal goes to the LKG where it is decrypted.

h. After decryption, the plain text data stream proceeds through the red P/P.

i. From the red P/P the data stream enters the LTU assigned to the originating subscriber or incoming trunk.

j. For outgoing transmission, this path and process is reversed.

QUESTIONS: What is the function of the modems in the CESG? (ANS: To convert the incoming signal to digital baseband signals.)

Explain the difference between the RED and BLACK patch panels? (ANS: RED is plain unencrypted data and BLACK is encrypted data).

15M

2. Information needed for space division interface planning.

a. Type of equipment, modem, and COMSEC you are interfacing with.

b. The 26-pair cable and pairs the signal is entering on.

NOTE: Refer to TM 11-5805-790-12-6, paragraph 7-31, page 7-95. Use diagram in student guide to illustrate how to determine which modem, LKG, and LTU to use.

(1) By knowing what cable and pairs the signal is entering, you can determine which modem, LKG, and LTU you will be using.

NOTE: Refer to TM 11-5805-790-12-6, paragraphs 7-19, page 7-42, and 7-24, page 7-50.

(2) After you have determined which modem, LKG, and LTU you will be using, determine which slot to install the appropriate modem and LTU.

c. Information necessary to determine what type modem to use and its correct strapping and alignment.

(1) Baud rate.
(2) Mode options.
(3) Crypto being used.
(4) Equalizer options.
(5) Transmit data information.
(6) Receive data information.

d. The correct variable to load into the LKGs to be compatible with the terminating equipment.

QUESTION: By knowing which cable and pairs a signal is coming in on, what else can you determine with this information? (ANS: The modem, LKG, and LTU you will need to use.)

3. Modem strapping procedures.

NOTE: Show Slide 2 and explain. Refer students to TM 11-5805-790-12-6, paragraph 7-20, page 7-44 for Type I modem-strapping options.

a. Type I - Three operational strapping options.

(1) Interface.
(2) Mode.

(3) Baud rate.

NOTE: Show Slide 3 and explain. Refer students to TM 11-5805-790-12-6, paragraphs 7-21, page 7-45 and 7-22, page 7-46 for Type II modem strapping options.

b. Type II: MOD 21 - Two operational strapping options.

(1) INTERFACE mode.
(2) EQUALIZER mode.

NOTE: Show Slide 4 and explain.

c. Type II: MOD 22 - Six operational strapping options.

(1) Mode.
(2) Baud rate.
(3) Transmit data.
(4) Transmit clock.
(5) Receive data.
(6) Receive clock.

NOTE: Show Slide 5 and explain.

d. Diphase loop modem (DILPM).

(1) Mode.
(2) Bit rate.

QUESTION: Which of the three modem types require two cards to comprise the modem? (ANS: Type II modem.)

1H 5M

4. Modem alignment procedures.

NOTE: Show Slides 6 and 7. Refer students to TM 11-5805-790-12-6, paragraphs 7-26, page 7-52 through 7-27, page 7-82 to illustrate modem alignment procedures. After introducing these procedures in the classroom, divide into groups of two and demonstrate these procedures in the message switch.

QUESTIONS: On a Type I modem, which test points do you connect the multimeter to adjust the transmit carrier alarm? (ANS: TP16 and TP26.)

On a Type II modem, which pot do you adjust the transmit signal level? (ANS: R10.)

4H 35M

5. Patching procedures.

NOTE: Show Slide 8 and explain.

a. Generally used to divert the signal path around faulty equipment rather than redesign the entire signal path.

b. Patch cords.

NOTE: Have the various patch cords available for the students to see. Refer to TM 11-5805-790-12-6, paragraph 7-30, page 7-84 through page 7-94.

(1) Single-lead patch cords - Used primarily to perform loopback of subscriber lines and equipment by connecting transmit to receive.
(2) Two-lead patch cords - Used in subscriber patch panels by placing one end of the patch cord in the line side. The white side in the transmit (jack) side and the black side in the receive (jack) side. Place the other end of the patch cord in the equipment side with

the white and black side inserted into the jacks in the same manner.

(3) Three-lead patch cords - Used in LKG P/Ps. Both ends of the patch cord will fit in the line side and equipment side, but will only go in one way.

(4) Four-lead patch cords - No longer used in the message switch was once used with inventory COMSEC.

NOTE: Continue having two at a time in the MS and demonstrate the types of patching that can be performed.

c. Types of patching.

(1) Loopback - Allows the testing of internal or external subscriber lines. Connect a single lead patch cord from the transmit to the receive side of either the line or equipment side of the channel (pairs) being tested.

(2) Subscriber patch - Used when a signal going through a 26-pair cable is not received as a result of a defective cable pair.

(a) Connect a two-lead patch cord from the equipment side of the failed channel to the line side of the newly selected cable pairs.

(b) Both the line and the equipment side of the subscriber input P/P are located in the black (left) patch panel rack of the CESG A8 through A10.

(c) The line side connects to the using subscriber through the SEP.

(d) The equipment side connects to analog and diphase side of the modems. The P/P allows the patching of any subscriber to any modem, as well as selective monitoring of any subscriber line.

(3) Modem patch - Used to patch around a bad modem by patching the original signal path to a spare modem.

(a) On the subscriber P/P, connect a two-lead patch cord from the line side of the defective channel to the equipment side of the spare of your choice. This isolates the faulted modem from the line.
(b) On the LKG black P/P, connect a two - lead patch cord from the equipment side of the faulted modem to the line side of the spare modem selected.
(c) Perform a LMOD command to complete the patching for this circuit.

(4) LTU patch - Used to patch around a defective LTU.

(a) On LKG red P/P, connect a three - lead patch cord from the line side of the failing channel to the equipment side of the channel selected as a spare LTU.
(b) Perform a LMOD command to modify the data base.

(5) LKG patch - Used to patch around COMSEC units that are defective.

(a) On the COMSEC black P/P, connect a three-or four-lead patch cord from the line side of the defective channel to the equipment side of the spare you have selected.
(b) On the COMSEC red P/P, connect a three-or four-lead patch cord from the equipment side of the faulted COMSEC channel to the line side of the spare selected.
(c) Perform a LMOD command to modify the data base.

(6) Crypto bypass patch - Used to bypass a COMSEC unit during fault isolation procedures.

Place one end of a modified 8-foot patch cord into the line side of the COMSEC red P/P.

QUESTION: What type patch cord is used to perform subscriber patching? (ANS: Two-lead patch cord.)

6H

6. Practical exercise.

a. Explanation to students. This is a two-part practical exercise.

(1) Part One. Use AN/TYC-39A; TM 11-5805-790-12-6; oscilloscope; digital multimeter; jewelers screwdrivers; and Practical Exercise, 150-74G10/J01-LP2-PE; to perform space division subscriber installation. You will be required to determine the correct signal path and populate modems, LTUs, and LKGs accordingly. You will also perform strapping, alignment, and patching as required. You will have 90 minutes to perform these tasks.

(2) Part Two. You must correctly answer 14 out of 20 written questions pertaining to space division subscriber functional.

(3) In Part One, have your instructor evaluate your performance after each exercise has been successfully completed.

(4) In Part Two, have your instructor grade the answers to your questions.

(5) If what you are required to do is not clear, ask your instructor for clarification.

b. Application by students.

(1) Part One. Using the AN/TYC-39A; TM 11-5805-790-12-6; an oscilloscope; digital multimeter; jewelers screwdrivers; and Practical Exercise, 150-74G10/J01-LP2-PE, the students will install space division subscribers by determining the correct signal path, populating modems, LTUs, and LKGs. They will also perform

strapping, alignment, and patching as required.

(2) Part Two. Using TM 11-5805-790-12-6 and Practical Exercise 150-74G10/J01-LP2-PE, the students will answer written questions about space division subscriber functional analysis.

c. Evaluation. During Part One of the practical exercise, evaluate each student to ensure they have the ability to determine the correct signal path, populate modems, LTUs, LKGs, and perform strapping alignment, and patching, as required. Each exercise will be evaluated individually. In Part Two, evaluate each student to ensure they can correctly answer at least 14 out of 20 questions pertaining to space division subscriber functional analysis.

17H 57M

SUMMARY:

In this lesson, you learned how to determine the signal path for space division subscribers, how to populate modems, LTUs, and LKGs accordingly; and how to strap align, and patch as necessary. As you learn how to install digital subscribers and perform data base procedures, this knowledge will be expanded.

In the next lesson, you will learn fault isolation procedures of the CESG and how to test the data path of a space division subscriber.

18H

END

This document supports Task Number 113-603-3216 and 113-603-3219.

PRACTICAL EXERCISE ANSWER KEY

PART ONE:
Question/Answer

1a. Type I modem
1b. Modem 01/A23A306

1c. J2 to J3
J5 to J6, J9 to J10
J11 to J12
1d. LKG 01
1e. LTU 01
1f. Observe the student make the adjustment to get -4 dB.
1g. Observe the student make the adjustment to get 2.0vdc
2a. Type II modem
2b. Modem 22/A23A333 (MOD22) and A23A331 (MOD21)
2c. J3 to J4
J5 to J6
J2 to J3
J9 to J10
J12 to J13
J15 to J16
J19 to J20
J21 to J22
2d. LKG 22
2e. LTU 22
2f. Observe the student make adjustment to -4 dB.
2g. Observe the student make adjustment to 2.1 vdc.
2h. Observe the student make adjustment to -4 dB.

3a. DILPM
3b. Modem 10/A23A233
3c. J11 to J12, J3 to J4, J6 to J7, J8 to J9
3d. LKG 10
3e. LTU 10

4. On J11, the student must patch from the line side of pairs 3 & 4 to the equipment side of pairs 9 & 10.

PART TWO:

All the questions selected for PART TWO are referenced in TM 11-5805-683-12-6.

Question/Answer	Reference
1. b	para. 7-19
2. d	"
3. d	"
4. d	para. 7-20
5. a	"
6. a	para. 7-22
7. c	"
8. c	para. 7-21
9. c	para. 7-22
10. d	para. 7-23
11. a	"
12. a	para. 7-26
13. b	"
14. c	"
15. c	"
16. b	para. 7-27
17. b	"
18. c	"
19. d	"
20. d	"

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LESSON PLAN

TITLE: AN/TYC-39A Space Division Fault Isolation and Repair

LEARNING OBJECTIVE:

Action: In Part One, the students will isolate and repair faults in the CESG space division by analyzing fault printouts, using fault isolation flowcharts, performing loopback tests, and replacing faulted components. In Part Two, the students will answer questions about CESG space division fault isolation and repair.

Conditions: The student will be given the AN/TYC-39A, TM 11-5805-790-12 series, TM 11-5805-790-34 series, and Practical Exercise, 150-74G10/F01-LP02-PE.

Standard: In Part One, acceptable performance is achieved when the student corrects CESG space division faults by analyzing fault printouts, using fault isolation flowcharts, performing loopback tests, and replacing faulted components within 1 hour. In Part Two, acceptable performance is achieved when the student correctly answers 7 out of 10 questions within 1 hour.

SAFETY CONSIDERATIONS: This lesson has safety hazards which may cause electrical shock or physical injury. Make sure students remove all jewelry and metal objects such as watches, rings, bracelets, and identification tags.

RISK ASSESSMENT: LOW.

APPROVAL DATE: DEC 11,1997
DEVELOPER: SSG Shank
DIV. CHIEF: Jack P. Rondon

RESOURCE NEEDS/ REFERENCES: AN/TYC-39A, TM 11-5805-790-12 Series, TM 11-5805-790-34 Series, Oscilloscope, Digital Multimeter, Jewelers Screwdrivers and tool kit.

METHODS OF INSTRUCTION: Conference, Practical Exercise

TIME: 13 Hours

NOTES TO INSTRUCTOR:

1. Ensure all training resources are available.
2. Ensure all safety procedures and practices are followed.
3. Ensure equipment is operational before and after class.

INTRODUCTION:

Elapsed Time

1. In the last lesson, you learned about the analog signal path and the procedures to install space division subscribers.
2. This lesson will focus on CESG space division fault isolation and repair. You will learn to analyze fault messages from the video display unit (VDU) and printouts from the line printer unit (LPU); use fault isolation flowcharts; perform loopback tests; and replace faulted components in the CESG. At the end of the lesson, you will be required to answer 7 out of 10 questions about CESG fault isolation and repair within 1 hour.

3. Let us begin the lesson by analyzing fault messages from the VDU and printouts from the LPU.

3M

BODY:

NOTE: Refer the students to TM 11-5805-790-12-8, paragraph 11-9, page 11-88 "Single Line Entry Subsystem (SLES) FI". Inform them that the preliminary procedures for CESG related fault isolation are covered in these sections. Main points 1 through 4 of this lesson will cover the details of the introductory portions of these sections.

The information needed to perform these steps are covered throughout the TM 11-5805-790-12 series and will be identified in each main point.

1. Fault messages and printouts. (VDU/LPU).

   a. Systems alarm area.

   NOTE: Refer to TM 11-5805-790-12-3, paragraph 5-7, page 5-6.

   (1) The only system alarm on the VDU screen that will lead you to a fault in the CESG is serious channel alarm (CHA).
   (2) This alarm will be displayed on row 3 of the supervisory VDU screen.

   b. Individual channel status area.

   NOTE: Refer to TM 11-5805-790-12-3, paragraph 5-8, page 5-9.

   (1) Provides information about a particular channel that is alarming.
   (2) This alarm will be displayed on rows 4 and 5 of the supervisory VDU screen.
   (3) Acknowledgement of channel or equipment status is done by depressing the ACKT key.

   (a) This causes the blinking channel in the CHANNEL STATUS SUMMARY partition to become steady.
   (b) The status of the channel is displayed in the INDIVIDUAL CHANNEL STATUS READOUT partition.

   (4) You can get a printout of the channel status by:

   (a) Depressing ACKT followed by depressing ACK.
   (b) Using the STAT command.

(c) Using the &NNN directive.

(5) Fields of information leading to CESG faults.

NOTE: Refer students to TM 11-5805-790-12-3, paragraph 5-8, page 5-9. There are 11 fields of information contained on the VDU screen. However, for the purpose of this lesson, emphasis will be placed on these fields: 1,2,7,8, and 11.

(a) Logical line number is the channel that is alarming.
(b) Service state shows whether the channel is in or out-of-service or is undefined.
(c) Channel status/alarm.

1. AOS indicates channel is out of service.
2. LBF - loopback test failed. Check LPU printout for detailed information.
3. LBP - loopback test passed.
4. CRF - crypto resync failure.
5. ALM - active alarm.

(d) Line termination number/modem number - Shows the LTU and modem number in the path of the alarm.
(e) Equipment status/alarms for modems.

1. MD:LBM - loopback mode.
2. MD:LRC - loss-of-receive carrier.
3. MD:LTC - loss-of-transmit carrier.

QUESTIONS: What are the three ways to obtain a channel status printout? (ANS: Depress ACD followed by ACKT, STAT command, &NNN.)

Which field of information tells you which channel is alarming? (ANS: Logical line number.)

45M

2. Channel management commands.

NOTE: Refer to TM 11-5805-790-12-3, paragraph 5-17, page 5-35 For the purpose of this lesson, only COSR, CISR, LOSR, and LISR "by individual channel" will be covered.

Inform the students that the preferred method of placing channels in or out of service is with CISR and COSR, rather than LISR and LOSR.

a. COSR - takes channel out-of-service.
b. CISR - places channel in service.
c. LOSR - takes channel out-of-service by using LTU number.
d. LISR - places channel in service by using LTU number.

QUESTION: What are the four commands that will place channels in or out-of-service? (ANS: COSR, CISR, LOSR, and LISR.)

1H 10M

3. Maintenance and equipment commands.

NOTE: Refer students to TM 11-5805-790-12-3, paragraph 5-27, page 5-234. For the purpose of this lesson, only the loopback (LPBK) command will be covered.

a. LPBK - initiates a loopback test. The sequence of running LPBKs is the following:

(1) LTU - checks to see if the LTU or the LTU card slot is defective.
(2) Modem - checks to see if the modem is defective, not strapped correctly, not aligned properly, is populated in a defective slot, or contains the wrong modem type.

(3) Remote.

(a) Place each end of a single plug patch cord in the EQUIP side of the subscriber patch panel.
(b) When the remote LPBK is run, the signal path through all the equipment is checked up to the signal entry panel (SEP) and back through the equipment.
(c) If the remote LPBK passes, this indicates that no faults exist in the signal path before it exits the switch.

(d) At this point, the maintainer is ready to test the signal path beyond the message switch. A series of remote LPBKs are required and all must pass to interface with the distant end equipment.

QUESTION: Name the three LPBK commands used for checking the signal path? (ANS: LTU, modem, and remote.)

1H 40M

4. Maintenance operation printouts.

NOTE: Refer students to TM 11-5805-790-12-4, paragraph 5-46, page 5-371. For the purpose of this lesson, only the LPBK test results will be covered.
LPBK test results - This printout occurs on the LPU when a Pass/Fail test result is received for a LPBK test. If LPBK fails, the following are things to troubleshoot and replace/repair in the appropriate manner required.

(1) Defective circuit card.
(2) Defective card slot.
(3) Improper modem strapping.
(4) Improper modem alignment.

(5) Signal path improperly assigned. (Wrong combination of modem-LKG-LTU).
(6) Defective cable.

QUESTION: Name two of the six things you would troubleshoot if a LPBK test fails? (ANS: Defective card or card slot.)

2H 10M

5. Organization level maintenance.

NOTE: The vast majority of organizational level maintenance required in the CESG involves circuit card removal/replacement, strapping, and alignment. These procedures were covered in last lesson. However, for review purposes, the following reference information will be provided to the students.

a. Circuit card removal and replacement - TM 11-5805-790-12-7, paragraph 10-16, page 10-40.

b. Modem strapping procedures - TM 11-5805-790-12-6, paragraph 7-20, page 7-44 through paragraph 7-23, page 7-48.
c. Modem alignment procedures - TM 11-5805-790-12-6, paragraph 7-26, page 7-52, and paragraph 7-27, page 7-82.

QUESTION: Which TM and paragraph covers circuit card removal and replacement? (ANS: TM 11-5805-790-12-6, paragraph 10-16.)

2H 25M

6. Direct support/general support (DS/GS) maintenance.

NOTE: Because of time constraints, DS/GS maintenance procedures cannot be taught in depth and detail; however, subjects that comprise DS/GS maintenance will be outlined with references. Use this outline and have the students locate the information in the TMs referenced. Briefly cover the material contained in each paragraph to familiarize the students with DS/GS maintenance procedures.

a. CESG cable interconnections.

NOTE: Refer students to TM 11-5805-790-34-3, Figure 6-1. Start with black SEP, J11 through J15, and lead the students through the cable interconnections until you terminate at the LTUs. Inform the students they may be required to replace cables during maintenance procedures.

b. Cable maintenance.

NOTE: Refer students to TM 11-5805-790-34-4, Table 7-1. This table shows the student where to locate information about a particular cable. Select a cable from the table list and illustrate information about a given cable.

c. Circuit card schematics.

NOTE: Refer students to TM 11-5805-790-34-3. Appropriate examples for this lesson will be shown in Figures 6-26, 6-27, and 6-45 (Type I and Type II modem cards). Also, refer students to TM 11-5805-790-12-6, paragraphs 7-26 and 7-27. Use the circuit card schematic diagram to show the students the signal path from the test points used for alignment and also the spots where the adjustments are made.

d. Digital line termination module (DLTM), communications interface control (CIC) card cage maintenance.

NOTE: Refer students to TM 11-5805-790-34-1, paragraph 2-35, page 2-36. Briefly cover the material contained in this paragraph.

e. Patch panel maintenance.

QUESTION: What TM and figure would you refer to for CESG cable interconnections? (ANS: TM 11-5805-790-34-3, Figure 1-6.)

3H

7. Practical exercise.

NOTE: The instructor will induce the faults that will generate the fault messages and printouts for the student to use fault isolation.

a. Explanation to students. This is a two-part practical exercise.

(1) Part One. Use the AN/TYC-39A, TM 11-5805-790-12 series, TM 11-5805-790-34 series; oscilloscope; digital multimeter; jewelers screwdrivers; and Practical Exercise, 150-74G10/G01-LP02-PE to perform CESG fault isolation and repair. You will be required to identify and analyze fault messages and printouts displayed on the VDU and LPU. With this information, you must be able to use fault isolation flowcharts, cable diagrams, perform LPBK tests to isolate faults, and repair those faults. Then you must place the channel back in service to verify the fault has been corrected. You will have 1 hour and 45 minutes to perform these tasks.

(2) In Part One, your instructor will evaluate your performance after each individual task has been successfully completed.

(3) Part Two. You must correctly answer 7 out of 10 questions pertaining to CESG fault isolation and repair within 1 hour.

(4) In Part Two, have your instructor grade the answers to your questions when you are finished.

(5) If what you are required to do is not clear, ask your instructor for clarification.

b. Application by students.

(1) Part One. Using the AN/TYC-39A; TM 11-5805-790-12 series; TM 11-5805-790-34 series; oscilloscope; digital multimeter; jewelers screwdrivers, and Practical Exercise, 150-74G10/G01-LP02-PE; the students will identify and analyze fault messages and printouts displayed on the VDU and LPU. With this information, they will use the fault isolation flowcharts, cable diagrams, perform LPBK tests to isolate faults, and repair those faults. After repairing, they will place the channel back in service to verify the fault has been corrected.

(2) Part Two. Using the TM 11-5805-790-12 series, TM 11-5805-790-34 series, and Practical Exercise, 150-74G10/G01-LP03-PE; the student will answer questions pertaining to CESG fault isolation and repair.

b. Evaluation. During Part One of the practical exercise, evaluate each student to ensure they have the ability to identify and analyze fault messages and printouts; use the correct fault isolation flowchart; cable diagram; perform LPBK tests; and repair faults.

After repairing the fault, have them place the channel back in service to verify the fault has been corrected.

12H 57M

SUMMARY:

In this lesson, you learned how to identify and analyze fault messages displayed on the VDU and LPU. With this information, you isolated and repaired faults by using the

fault isolation charts and cable diagrams. You will continue to perform this type in future lessons as you increase your knowledge and maintenance skills of the AN/TYC-39A message switch. In the next lesson, you will learn the functional of the time division interface group (TDIG).

13H

END

This document Supports Task Number 113-603-3216 and 113-603-3219.

PRACTICAL EXERCISE ANSWER KEY

PART ONE:

The instructor will induce faults that will generate fault messages/printouts in Part One. Evaluate the students and ensure they list the correct information on the attached "Fault sheets".

PART TWO:

Question/Answer		Reference
1.	b	TM 11-5805-790-12-3, para. 5-7 pg 5-6
2.	d	TM 11-5805-790-12-3, para. 5-8 pg 5-9
3.	d	TM 11-5805-790-12-8, para. 11-9 pg 11-88
4.	b	TM 11-5805-790-12-3, para. 5-11 pg 5-18
5.	a	TM 11-5805-790-12-3, para. 5-27 pg 5-235
6.	c	TM 11-5805-790-34-4, table 7-1 pg 7-1
7.	a	TM 11-5805-790-34-3, fig. 6-2
8.	c	TM 11-5805-790-34-3, fig. 6-2
9.	b	TM 11-5805-790-34-3, fig. 6-26 pg 6-204
10.	b	TM 11-5805-790-34-4, table 7-1 pg 7-1

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LESSON PLAN

TITLE: AN/TYC-39A Time-Division Interface Group Modified

LEARNING OBJECTIVE:

Action: The student will describe the TDIGM functions and will perform TDIGM maintenance, which will include removal and replacement.

Conditions: The student is given the Student Guide, TM-11-5805-790-12 and 34 series, an AN/TYC-39A, multimeter, oscilloscope, tool kit and Practical exercise.

Standard: The standard has been met when the student can correctly answer at least 14 out of 20 in questions in 1 hour and populate the TDIGM nest.

SAFETY CONSIDERATIONS: Make sure equipment is powered down before making any electrical connections. Remove all jewelry before starting any procedures.

RISK ASSESSMENT: A risk assessment has been conducted on this unit of instruction and the risk level is deemed to be: LOW RISK.

RESOURCE NEEDS/ REFERENCES: AN/TYC-39A, Student guide, TM 11-5805-790-12 and 34 series technical manuals, multimeter, oscilloscope, tool kit and practical exercise.

METHODS OF INSTRUCTION: Conference, Practical Exercise

TIME: 18 Hours

NOTES TO INSTRUCTOR:

1. Ensure that the classroom is available and properly set up and that all equipment and training resources are available and in working order.

APPROVAL DATE: DEC 11,1997
DEVELOPER: SSG Shank
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2. Ensure that enough technical manuals and Student Guides are available and account for all transparencies.
3. Before the end of class, evaluate students on their ability to perform the learning objective.
4. State all safety notes as they appear throughout the lesson plan.

INTRODUCTION:

Elapsed Time

To successfully maintain the AN/TYC-39A, you need good working knowledge of the TDIGM. The TDIGM is the primary interface to the circuit switch. In this lesson, we will study the details of the TDIGM.

BODY:

1. TDIGM Rack Map.

NOTE: Refer to TM 11-5805-790-12-6, para 7-16, page 7-38.

a. Row 1 (TDIGM) and Timing.

(1) Remote Transfer Switch (RTS.)

(a) Slot 4 = RTS A.
(b) Slot 24 = RTS B.
(c) RTS cards are database (HTDM) selectable.

(2) NSYLK Cards - NSYLK cards 1 through 7 are in slots 12-15 and 32-34.
(3) TDIM A and TDIM B.

(a) GPMDM - Group Modem - Slots 07 and 27.
(b) TGMOW - Transmission Group Module Order wire, slots 08 and 28.
(c) MXDMX - MUX DEMUX card, slots 09 and 29.
(d) ATDLY - Auto Delay Card, slots 10 and 30.

(4) Trunk Signaling TDIM A and B.

(a) TSB - Trunk Signaling buffer, slots 16 and 35.
(b) SBCC - Signaling buffer controller, slots 17 and 36.

(5) Master Timing Generators A and B.

(a) LTGARED A and B, slots 11 and 31.
(b) LTGA Black A and B, slots 5 and 25.
(c) MCBM - Modem Clock Buffer Monitor A and B, slots 06 and 26.
(d) MTGSY -Master Timing Synthesizer A and B, slots 20 and 39.
(e) MTGS4 -A and B, slots 22 and 41.

NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

QUESTIONS: What is the rack designator for the TDIGM? (ANS: A23.)

What rack, row, and slot number is the TDIGM-B RTS card in? (ANS: A23A124.)

30M

2. TDIGM Functional Description.

NOTE: Show Slide 1.

a. The new TDIGM is functionally equivalent to the existing TDIM.

(1) The TDIGM provides the Automatic Message Switching Central AN/TYC-39A with a high-speed digital interface to the message switch compatible circuit switch.

(a) TTC-39.
(b) TTC-39A
(c) TTC-39A(V)3.
(d) TTC-39A(V)4.
(e) TTC-39D.
(f) TTC-39D/PS.
(g) NCS.
(h) LEN.

(2) The TDIGM provides a full-duplex, time-division multiplexed data and control interface to the Circuit Switch (CS.)

b. There are two redundant TDIGM functions.

(1) Time-Division Interface Module-A (TDIM-A.)
(2) Time-Division Interface Module-B (TDIM-B.)

c. There is a patch panel and SEP appearance for each TDIGM.

(1) The AN/TYC-39A has a separate interface for each TDIM (different PCM cable connector.)
(2) The AN/TYC-39A has a separate patch panel appearance for each TDIM (different blue plug patch connectors.)

d. Processor-Controlled Strapping (PCS) of TDIMs replaces manual strapping.

(1) PCS reduces wear and tear on circuit cards.
(2) Circuit cards are strapped automatically.
(3) Circuit cards are re-strapped automatically when removed/replaced.
(4) Processor-controlled strapping is available for:

(a) Remote Transfer Switch (RTS.)
(b) Group Modem (GM.)
(c) Transmission Group Module Orderwire (TGMOW.)
(d) Loop Key Generator Selector (NSYLK.)
(e) Trunk Signaling Buffer (TSB.)

e. Automatic synchronization replaces resync panels.

(1) The TDIMs automatically resync themselves (if possible) after sync is lost.
(2) If resync is not possible, an alarm printout occurs.

f. Recovered clock is routed to MTG based on processor command.

(1) The MTG may be slaved off of a timing source received on either Time-Division Interface Module (TDIM.)
(2) The selection of slave or master is done by strapping.

(3) The following is a list of timing options:

(a) Master.

(b) Slave TDIM A (if on-line.)
(c) Slave TDIM B (if on-line.)

g. Switched Lines.

(1) Processor-controlled selection of 35 LKG outputs to either TDIM A or TDIM B or loop modems eliminates cabling changes.

(a) This is performed by the NSYLK card.
(b) Only 35 LKG outputs are switched, because DTG max is 36 channels and channel 1 is signaling (no LKG on signaling.)
(c) The LKG output selection is done manually (by moving the cable) in the AN/TYC-39(V)1.

(2) The NSYLK card selections are controlled by the Table Generate (TGEN) command.

INSTRUCTOR NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

QUESTIONS: What is the maximum number of outputs on the TDIGM? (ANS: 35)

What are the timing options of the TDIGM? (ANS: Master, slave)

How are the timing options set on the TDIGM? (ANS: By manual strapping the card)

1H 10M

3. TDIGM Block Diagram.

INSTRUCTOR NOTE: Show Slide 2.

a. There are two redundant TDIGM functions.

(1) Time-Division Interface Module-A (TDIM-A.)
(2) Time-Division Interface Module-B (TDIM-B.)

b. Major Components within the TDIGM.

(1) Remote Transfer Switch (RTS.)
(2) The TDIM is made up of the following:

(a) Group Modem (GM.)
(b) Transmission Group Module Orderwire (TGMOW.)
(c) 36-channel Multiplexer/Demultiplexer (MUX/DEMUX.)
(d) TDIGM Interface Control Automatic Delay (ATDLY.)
(e) Trunk Signaling Buffer (TSB.)
(f) Signaling Buffer Controller(SBC.)

(3) Trunk Encryption Device (TED) - Part of Common Equipment Facility (CEF.)

(4) LKG Selector (NSYLK.)
(5) Patch Panels - Part of Communication Equipment Support Group (CESG.)

c. Remote Transfer Switch (RTS) performs the following functions.

INSTRUCTOR NOTE: Show Slide 3.

(1) Under processor control via the ATDLY, the RTS provides the switching to connect the on-line group modem to the circuit switch.
(2) Provides the recovered clock to the ATDLY.
(3) Is a two-position multi-pole switch controllable by the processor via the ATDLY.
(4) Redundant RTS functions in the system and the processor control both RTSs.
(5) Interfaces with each TDIM GM.
(6) Places one TDIM on-line.
(7) Switches the on-line group modem to the coaxial cable.
(8) Enables substitution of the off-line unit to on-line status by Automatic Data Processor (ADP) software control.

d. Group Modem Block Diagram.

INSTRUCTOR NOTE: Show Slide 4.

(1) The group modem transmits and receives either dipulse or diphase modulated data to/from the RTS, which is then sent over to the circuit switch.
(2) The group modem receives dipulse or diphase in via the RTS to the equalizer.

(a) The equalizer attenuates the incoming signal to account for the proper cable length.

1. The amount of attenuation is dictated by the processor-controlled strapping.
2. The attenuation can be set up to one mile, with a one-quarter mile increment, via PCS.

a. The data from the equalizer is then sent to the timing circuit and the data DEMOD circuit.

(3) The timing circuit derives recovered clock from the data input.

(a) The timing circuit outputs recovered clock to the ATDLY.
(b) The timing circuit also outputs DEMOD carrier to the fault circuit.

(4) The data demodulator circuit receives the data from the equalizer circuit.
(5) The data demodulator circuit decodes the data.

(a) The data is sent out to the TGMOW card as baseband data.
(b) The data demodulator also sends out DEMOD activity to the fault circuit.

(6) The data modulator receives baseband data from the TGMOW card.

(a) This data modulator then sends two signals out:

1. Carrier detect, which goes out to the fault circuit.
2. Diphase or dipulse data out to the RTS, to be sent to the circuit switch.

(b) Activity detect is sent to the fault circuit before it enters the data modulator circuit.

(7) The fault circuit receives four inputs and generates one output.

(a) Inputs.

1. Modulator Carrier Detect.
2. Modulator Activity Detect.
3. Demodulator Activity Detect.
4. Demodulator Carrier Detect.

(b) Output - Alarm status, which is sent to the ATDLY card.

e. Transmission Group Module Orderwire (TGMOW) Card.

INSTRUCTOR NOTE: Show Slide 5.

(1) The TGMOW provides:

(a) Group Clock Selector (GCLK.)
(b) Transmission Group Module (TGM.)

1. Group Buffer (GB.)
2. Group Framing Unit (GFU.)

(2) GCLK Functional Description.

(a) The GCLK provides RED or BLACK clocks to the GM using a control line from the Trunk Group Modem (TGM.)
(b) A RED/BLACK fault alarm is reported to the TDIGM ATDLY card.
(c) The GCLK provides four clock frequencies.

1. 4.608 MHz.
2. 4.096 MHz.
3. 3.072 MHz.
4. 100 Hz sync pulse.

(3) Trunk Group Modem (TGM) - The TGM provides timing adjustment and time delay.

(a) The FIFO buffer in the GB provides a minimum storage capability of plus or minus 256 bits at the maximum DTG rate of 4.608 Mb/s.
(b) At all DTG frequencies, the buffer size is large enough to permit operation over a 24-hour period using independent atomic standards which come from the circuit switch.

(4) Group Buffer Functional Description.

(a) The GB receives digital data and data clock from the group modem.
(b) The buffer is organized as a First-In/First-Out (FIFO), with the data output in the same order as input.

1. The buffer is set initially to 50-percent full and, depending on the difference between the two clock rates, will gradually empty or fill.
2. The buffer size is selected by Processor-Controlled Strapping (PCS) to:

a. 128 bits plus or minus 64.
b. 256 bits plus or minus 128.
c. 512 bits plus or minus 256.
d. This is based on the 32-kb/s loop rate.

3. The buffer size is for 16-kb/s loop rate.

a. 64 bits plus or minus 32.
b. 128 bits plus or minus 64.
c. 256 bits plus or minus 128.

(c) The state of the buffer is monitored continually for a full or empty condition.
(d) This status is reported to the processor via device controller as a FIFO full/empty status bit in the TGM status report.
(e) The PCS provides parameters for channel size, switch loop rate, and DTG loop rate.

(5) Group Framing Unit Functional Description.

(a) Decrypted data from the TED is available for frame acquisition before demultiplexing and switching.
(b) The 32/16-kb/s channels are grouped in 8, 9, 16, 18, 32, and 36 channel groups, which are each serviced by a single TGM.

(c) Framing information is transmitted on a 4/2-kb/s subchannel.
(d) Thus, in a 36-channel transmission group with each channel operating at 32/16 kb/s, there are 511 bits between successive framing bits in a major frame.
(e) During acquisition of framing, only zeros and the framing pulses are transmitted on the DTG.
(f) The Automatic Frame Circuit (AFC) provides DTG resynchronization at the completion of a timeout.

f. 36-Channel MUX/DEMUX Card Functional Description.

INSTRUCTOR NOTE: Show Slide 6.

(1) The MUX/DEMUX card demultiplexes a baseband group from the TGMOW into an overhead channel and up to 35 traffic channels.

(a) The overhead bit of the first minor frame is the framing bit and is tested for activity.
(b) Overhead bits 2-5 are fed to the TSB for common channel signaling via ATDLY card.

(c) Overhead bits 7 and 8 are not used or monitored.

(2) The 35 traffic channels are sent to an LKG selector, 5 channels per NSYLK card.

(a) One NSYLK card can only handle five channels.
(b) There are seven NSYLK cards circuits to handle up to 35 channels.

g. Timing Interface Control Automatic Delay (ATDLY) Card Functional Description.

INSTRUCTOR NOTE: Show Slide 7.

(1) The AN/TYC-39A contains two ATDLY cards, one for each TDIM, that provide a number of functions required to operate a TDIGM.

(2) The ATDLY card provides an interface with the processor via the CAP that is used to distribute commands received and to collect status from the circuit cards in the TDIM.

(a) These commands set the channel size.

(b) These commands also set the channel rate and other parameters required.

(3) The ATDLY card also controls the recovered clock routing to the MTG and the MUX/DEMUX group rate clock selection based on the commands received from the processor.
(4) The ATDLY card provides a delay required to align the TSB with TGMOW master frame.
(5) The ATDLY card also provides an SBC address encoding/decoding function for information exchanged with the TSBs.
(6) The ATDLY card issues a command to each of the NSYLK cards to select the output of each device.
(7) The ATDLY card receives group rate clock selection from the RED Local Timing Generator (LTGA.)
(8) The ATDLY card issues a command to the TGMOW card to control the output.

h. Trunk Signaling Buffer (TSB.)

INSTRUCTOR NOTE: Show Slide 8.

(1) Processor-controlled strapping is done immediately upon completion of system power-up.
(2) Trunk signaling parameters are received from the ATDLY.
(3) A card presence is returned to the ATDLY card.
(4) The TSB is used to encode, decode, format, and buffer data exchanged between two communication switches on the overhead channel of a DTG or over a separate quasi-analog signaling channel.
(5) Data is transferred into the output buffer over the output data transfer line when:

(a) The data transfers clock, which clocks the data in.

(b) The output data transfer enable is set.

(6) When the output buffer is ready to accept more data, the output buffer ready signal is set.
(7) Data is then encoded by the quasi-cyclic encoder and transmitted to the subchannel MUX/DEMUX if the signaling channel is to be part of a DTG.

(a) The subchannel MUX/DEMUX inserts or extracts framing.
(b) The Type 4B MUX/DEMUX is inserted when a 16-kb/s DTG is received as part of a mixed 16/32-kb/s DTG.

(8) Received data from the subchannel MUX/DEMUX is tested for errors in the quasi-cyclic decoder.
(9) The control character detector detects the code words indicating:

(a) Start of Message (SOM.)
(b) End of Message (EOM.)
(c) Idle.

(10) SOM and EOM are used to indicate the presence of a received message and to initiate data transfer out of the TSB via the input buffer.
(11) Character synchronizer is used to decode the incoming data. This is done for the quasi-cyclic decoder.

(12) The card identifier compares the command address bits against a nest-wired address for that particular slot.
(13) Input/output signaling rate is either 2400 bits per second or 1200 bits per second, depending on the 1.2/2.4-kHz analog channel clock.
(14) Master Reset - The TSB clears both data buffers and initiates a character-sync search.
(15) There are two signals from the signaling buffer controller.

(a) Subchannel 2 - This indicates that trunk A is being used.
(b) Subchannel 3 - This indicates that trunk B is being used.

(16) The 2-kHz clock data out clocks out the 36 channels.
(17) Subchannel data in enable is for the data entering the subchannel MUX/DEMUX.
(18) Framing is used on the TGMOW card.

i. Signaling Buffer Controller Block Diagram.

INSTRUCTOR NOTE: Show Slide 9.

(1) Functional Description - The SBC provides the interface between the ATDLY card and the processor Input/Output Expander (IOE.)
(2) The ATDLY card provides the interface between the TSBs and the SBC.

INSTRUCTOR NOTE: Inform the students that the SBC sends data through the ATDLY card to the TSB.

(3) The SBC performs the function of routing messages and commands between the IOE and the TSBs via the ATDLY.
(4) The SBC is fully redundant and capable of being connected to either processor.
(5) The active SBC and the standby SBC have completely independent interfaces with the TSB devices.
(6) The interface between SBC-A and ATDLY-A are completely independent of the interface between SBC-B and ATDLY-B.

(7) The SBC occupies two IOE addresses.

(a) One corresponding to the SBC transmit controller.
(b) The other to the SBC receive controller.

(8) All messages are transmitted to the signaling channel via the SBC transmit controller.
(9) All messages are received from the signaling channel via the SBC receive controller.

j. NSYLK Card Block Diagram.

INSTRUCTOR NOTE: Show Slide 10.

(1) The AN/TYC-39A contains seven NSYLK cards which provide processor selectable outputs for up to 35 traffic channels from LKGs.
(2) The processor side of each NSYLK card interfaces with five LKGs.
(3) The line side of each NSYLK card interfaces with:

(a) MUX/DEMUX-A.
(b) MUX/DEMUX-B.
(c) Loop modems.

(4) The processor, via the ATDLY card, selects the NSYLK cards desired output.
(5) NSYLK also provides status to the processor via ATDLY card.
(6) The NSYLK provides level conversion from TTL to low-level differential signals used on the LKG channels when the outputs are selected for the MUX/DEMUX.
(7) When the processor selects the loop modems as the output, the NSYLK provides no level conversion.
(8) If there are only one or two channels coming from the MUX/DEMUX, they take one entire NSYLK card.

INSTRUCTOR NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

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4. TDIGM Interfaces

INSTRUCTOR NOTE: Refer students to Information Sheet E1-1, AN/TYC-39A NSYLK card Interface Block Diagram Foldout, and E1-2, AN/TYC-39A SBCC/ALTDY/TSB Interface Block Diagram Foldout. Use throughout the next section.

a. The TDIGM has the following interfaces:

(1) CAP to ATDLY.
(2) TGMOW to TED.

(3) LKG Selector to Loop Modem.
(4) RTS to Group Modem.
(5) Group Modem to TGMOW.
(6) TGMOW to MUX/DEMUX.
(7) MUX/DEMUX-A to ATDLY-A to TSB-A.
(8) TSB-A to ATDLY-A.
(9) ATDLY to SBC.
(10) RTS to ATDLY.
(11) Group MODEM-A to ATDLY.
(12) TGMOW-A to ATDLY-A.
(13) MUX/DEMUX to LKG Selector.
(14) ATDLY to LKG Selector.

b. CAP-to-ATDLY Interface - The means by which the CAP exchanges information with the ATDLY card function.

INSTRUCTOR NOTE: Show Slide 11.

(1) The CAP issues 32-bit Output From Register (OFR) commands to the ATDLY to configure the TDIM equipment.

(a) Signal - CMD DATA.

1. Destination: CAP to ATDLY = Command Data.
2. Function: The CAP issues 32-bit OFR commands to the ATDLY using this line.

(b) Signal - CMD EN.

1. Destination: CAP to ATDLY = Command Enable.
2. Function: The CAP activates this line to enable the transfer of 32-bit OFR command to the ATDLY card.

(2) The CAP also requests 32-bit Input to Register (ITR) status words from the ATDLY to determine the state of the TDIM.

(a) Signal - STAT DATA.

1. Destination: ATDLY to CAP = Status Data.
2. Function: This line is used to transfer 32-bit ITR words from the ATDLY to the CAP.

(b) Signal - STAT EN.

1. Destination: CAP to ATDLY = Status Enable.
2. Function: The CAP activates this line to enable the transfer of 32-bit ITR words to the CAP.

(3) The CAP provides control of the enable and address line for the exchange of commands and status.

(4) Signal - STAT ADDRESS.

(a) Destination: CAP to ATDLY = Status Addressing.

(b) Function: The CAP seta these four lines to address the ATDLY it wants to read ITR status from.

c. TGMOW-to-TED Interface - Handles both bulk-encrypted trunk data and bulk-unencrypted trunk data

INSTRUCTOR NOTE: Show Slide 12.

(1) The interface between the TED and the BLACK TGMOW handles bulk-encrypted data.

(a) Signal – RCT.

1. Destination: TGMOW to TED.
2. Description: Receive Cipher Text - This line carries BLACK receive data.

(b) Signal – RCTC.

1. Destination: TGMOW to TED.
2. Description: Receive Cipher Text Clock - This signal clocks the BLACK receive data into the TED.

(c) Signal – TCT.

1. Destination: TED to TGMOW.

2. Description: Transmit Cipher Text - This line carries BLACK transmit data.

(d) Signal – TCTC.

1. Destination: TED to TGMOW.
2. Description: Transmit Cipher Text Clock- This signal clocks the BLACK transmit data into the TGMOW.

(2) The interface between the TED and the RED TGMOW handles bulk-unencrypted data.

(a) Signal – RPT.

1. Destination: TED to TGMOW
2. Description: Receive Plain Text - This line carries RED receive data.

(b) Signal – RPTC.

2H 40M

1. Destination: TED to TGMOW.
2. Description: Receive Plain Text Clock - This signal clocks the RED receive data into the TGMOW.

(c) Signal – TPT.

1. Destination: TGMOW to TED.
2. Description: Transmit Plain Text - This line carries RED transmit data.

(3) Signal - BLACK STATION CLOCK.

(a) Destination: TGMOW to TED.
(b) Description: BLACK Station Clock - A RED station clock is generated from the BLACK station clock to clock the RED transmit data into the TED.

d. NSYLK card-to-Loop Modem Interface - One of the three interfaces from the NSYLK card devices.

INSTRUCTOR NOTE: Show Slide 13.

(1) The other two are TDIM-A and TDIM-B.

(a) This interface is the default selected by the NSYLK card device upon power up.
(b) The interface is also be selectable by the processor via the ATDLY function.

(2) The interface switches the data and clock lines from the loop modems to the LKGs.
(3) Signal - ML RX DATA.

(a) Destination: Modem to NSYLK card.
(b) Description: Receive Data (5) - This line carries encrypted data from the line to the LKGs. Five receive data lines are switched when the loop modems are selected.

(4) Signal - LM TX DATA.

(a) Destination: NSYLK card to Modem.
(b) Description: Transmit Data - This line carries encrypted data to the line from the LKGs. Five transmit data lines are switched when the loop modems are selected.

(5) Signal - ML CLK MODEM.

(a) Destination: NSYLK card to modem.
(b) Description: Supplied Clock - This line carries the clock signal used to exchange data with the LKGs. Five clock signal lines are switched when the loop modems are selected.

e. RTS-to-Group Modem Interface.

INSTRUCTOR NOTE: Show Slide 14.

(1) Transmits and receives data to and from the circuit switch.
(2) It also sends recovered clock and clock alarm through the RTS.
(3) Signal - DIPHASE/DIPULSE DATA OUT-AA.

(a) Destination: GM-A to RTS-A.
(b) Description: This line carries the transmit diphase/dipulse data.

(c) This line also handles the DIPHASE/DIPULSE DATA OUT-AB which is GM-A to RTS-B.

(4) Signal - DIPHASE/DIPULSE DATA OUT-BA.

(a) Destination: GM-B to RTS-A.
(b) Description: This line carries the transmit diphase/dipulse data.
(c) This line also handles the DIPHASE/DIPULSE DATA OUT-BA which is GM-B to RTS-A.

(5) Signal - DIPHASE/DIPULSE DATA IN-AA.

(a) Destination: RTS-A to GM-A.
(b) Description: This line carries the receive diphase/dipulse data.
(c) This line also handles the DIPHASE/DIPULSE DATA IN-BA which is RTS-B to GM-A.

(6) Signal - RECOVERED CLOCK-AA.

(a) Destination: GM-A to RTS-A.
(b) Description: This line carries the clock recovered by the group modem from the receive data.
(c) This line also handles the RECOVERED CLOCK-AB which is GM-A to RTS-B.

(7) Signal - RECOVERED CLOCK-BA.

(a) Destination: GM-B to RTS-A.
(b) Description: This line carries the clock recovered by the group modem from the receive data.
(c) This line also handles RECOVERED CLOCK-BB which is GM-B to RTS-B.

(8) Signal - DIPHASE/DIPULSE DATA IN-BB

(a) Destination: RTS-B to GM-B
(b) This line carries the receive diphase/dipulse data.
(c) This line also handles receive DIPHASE/DIPULSE DATA IN-AB which is RTS-A to GM-B.

f. GM-to-TGMOW Interface - The means by which baseband data is transferred between the GM and the TGMOW.

INSTRUCTOR NOTE: Show Slide 15.

(1) This interface is the vehicle that supplies the GM clocks from the TGMOW card.

(a) Signal - DATA OUT.

1. Destination: TGMOW to GM.
2. Description: Data Out - This line carries the transmit baseband data from the TGMOW to the GM.

(b) Signal - DATA IN.

1. Destination: GM TGMOW.
2. Description: Data In - This line carries the demodulated receive baseband data from the GM to the TGMOW.

(c) Signal - REC CLK.

1. Destination: GM TGMOW.
2. Description: Data Recovered Clock - This line carries the clock signal recovered by the GM from the receive data.

(2) This interface also provides for a recovered clock and a card presence indicator.

(a) Signal - CARD PRES.

1. Destination: GM to TGMOW.
2. Description: Card Presence Indicator - This line indicates GM card presence to the TGMOW.

(b) Signal - 4.608 MHz.

1. Destination: TGMOW to GM.

2. Description: 4.608 MHz clock - This line carries either a RED or BLACK clock rate required by GM.

(c) Signal - 4.096 MHz.

1. Destination: TGMOW to GM.
2. Description: 4.096 MHz Clock - This line carries either a RED or BLACK clock rate required by GM.

(d) Signal - 100 Hz SYNC.

1. Destination: TGMOW to GM.
2. Description: 100 Hz Sync Pulse - This line carries either a RED or BLACK clock rate required by GM.

g. TGMOW-to-MUX/DEMUX Interface.

INSTRUCTOR NOTE: Show Slide 16.

(1) Provides digital receive baseband serial data stream to the MUX/DEMUX.
(2) This is used for demultiplexing into the required number of data channels.
(3) Signal - DEMUX DATA.

(a) Destination: TGMOW to MUX/DEMUX.
(b) Description: Demultiplex - This line carries synchronized receive trunk group data to the demultiplexer portion of the MUX/DEMUX.

(4) The MUX/DEMUX provides the TGMOW with a multiplexed serial data stream for transmission over the trunk group.
(5) Signal - MUX DATA.

(a) Destination: MUX/DEMUX to TGMOW.
(b) Description: Multiplex - This line carries transmit trunk group data from the multiplexer portion of the MUX/DEMUX.

(6) In the off-line/loopback mode, one 32-kb/s active channel is provided to the SBC via the MUX/DEMUX.

h. MUX/DEMUX-to-ATDLY Interface - Enables the ATDLY card to insert a delay to align the TSB with the TGMOW master frame.

INSTRUCTOR NOTE: Show Slide 17.

(1) The delay is four bits.

(a) ±1 bit on the receive data to the TSB.

1. Signal: MT IN DAT A.
2. Destination: ATDLY card-A to TSB-A

3. Description: Input Data - This line carries received common signaling channel data from the MUX/DEMUX.

(b) Also one bit on transmit, ±1 bit, data to the MUX/DEMUX.

1. Signal: MT OUT DAT A.
2. Destination: TSB-A to ATDLY card-A
3. Description: Output Data - This line carries transmit common signaling channel data to the MUX/DEMUX.

3H 15M

(2) The delay is based on the group rate clock.

(a) The MUX/DEMUX-to-ATDLY card interface selects a group rate clock to be routed to the MUX/DEMUX.
(b) The ATDLY card selects the group rate clock based on commands received from the processor.
(c) Signal name GRCLK.

(3) The MUX/DEMUX also supplies:

(a) DEMUX Fault - Signal name DEMUX FLT.
(b) MUX Fault - Signal name MUX FLT.
(c) Card Presence Indicator - Status lines to the ATDLY card - Signal name CARD PRES.

(4) This shows the MUX/DEMUX-A to ATDLY card-A. Only the MUX/DEMUX-B to ATDLY card-B functions the same when on-line.

i. ATDLY-to-TSB Interface - Supports an SBC encoder/decoder function on data exchanged between the TSB and SBC.

INSTRUCTOR NOTE: Show Slide 18.

(1) The ATDLY decodes the SBC address and routes the information to the TSB.

(a) Signal - IN BUF AA.

1. Destination: TSB-A to ATDLY-A.
2. Description: Input Buffer Ready - This line indicates that the TSB has a message to input to the processor.

(b) Signal - IN DAT AA.

1. Destination: TSB-A to ATDLY-A.
2. Description: Input Data Line - This line carries received common signaling data to the SBC.

(c) Signal - IN EN AA.

1. Destination: ATDLY-A to TSB-A.
2. Description: Input Data Enable - This signal enables the transfer of signaling data from the TSB to the ATDLY.

(d) Signal - MAS EN IN A.

1. Destination: ATDLY-A to TSB-A.
2. Description: Master Enable In - This line enables the transfer of input data from the TSB to the SBC.

(2) The ATDLY receives data from the TSB and encodes the proper address before transmission to the SBC.

(a) Signal - OUT BUF AA.

1. Destination: TSB-A to ATDLY-A.

2. Description: Output Buffer READY - This line indicates that the TSB is ready to receive a message from the processor.

(b) Signal - OUT DAT AA.

1. Destination: ATDLY-A to TSB-A.
2. Description: Output Data Line - This line carries the outgoing signaling messages from the processor.

(c) Signal - OUT EN AA.

1. Destination: ATDLY-A to TSB-A.
2. Description: Output Data Enable - This signal enables the transfer of signaling data from the ATDLY card to the TSB.

(d) Signal - MAS EN OUT A.

1. Destination: ATDLY-A to TSB-A.

2. Description: Master Enable Out - This line enables the transfer of output data to the TSB from the SBC.

(3) The SBC encoder/decoder interface also provides an electrical level conversion from differential levels to TTL.

(4) Signal - MR AA.

(a) Destination: ATDLY-A to TSB-A.
(b) Description: Master Rest - This signal enables the TSB to be reset to a known state.

(5) Signal - CMD DAT A.

(a) Destination: ATDLY-A to TSB-A.
(b) Description: Command Data In - This signal carries the TSB strapping command received from the processor.

(6) Signal - CMD EN A.

(a) Destination: ATDLY-A to TSB-A.

(b) Description: Command Data In Enable - This signal enables the transfer of command data from the ATDLY to the TSB.

(7) Signal - CARD PRES A.

(a) Destination: TSB-A to ATDLY-A.
(b) Description: Card Presence Indicator - This line indicates TSB card presence.

j. ATDLY-to-SBC Interface - Required to perform the SBC encoder/decoder function.

(1) This interface contains the required signals to decode/encode addressing to allow proper communication between the TSBs and SBC.
(2) Signal - TS IN BUF.

(a) Destination: ATDLY to SBC.
(b) Description: Input Buffer Ready - This line indicates that the ATDLY has a message to input to the processor.

(3) Signal - TS IN DATA.

(a) Destination: ATDLY to SBC.

(b) Description: Input Data - This line carries received common signaling channel data from the ATDLY.

(4) Signal - ST IN DAT EN.

(a) Destination: SBC to ATDLY.
4H (b) Description: Input Data Enable - This signal enables the transfer of signaling data from the SBC to the ATDLY.

(5) Signal - ST RESET.

(a) Destination: SBC to ATDLY.
(b) Description: Reset - This signal enables the TSB to be reset to a known state.

(6) Signal - ST ME IN.

(a) Destination: SBC to ATDLY.
(b) Description: Master Enable In - This address line enables the transfer of input data from the TSB to the SBC.

(7) Signal - ST ME OUT.

(a) Destination: SBC to ATDLY.
(b) Description: Master Enable Out - This address line enables the transfer of output data from the TSB to the SBC.

(8) Signal - TS OUT BUF.

(a) Destination: ATDLY to SBC
(b) Description: Output Buffer Ready - This line indicates that the TSB is ready to receive a message from the processor.

(9) Signal - ST OUT DAT.

(a) Destination: SBC to ATDLY.
(b) Description: Output Data - This line carries transmit common signaling channel data to the TSB.

(10) Signal - ST OUT DAT EN.

(a) Destination: SBC to ATDLY.

(b) Description: Output Data Enable - This line enables the transfer of signaling data from the SBC to the ATDLY.

k. RTS-to-ATDLY card Interface - Performs two functions in the TDIGM.

INSTRUCTOR NOTE: Show Slide 19.

(1) First, the ATDLY exchanges commands and status information with the RTS to configure the device as connected to TDIM-A or TDIM-B.

(a) The ATDLY configures the RTS when commanded.

(b) It also issues RTS configuration status when requested by the processor.

1. Signal - SEL RTS AA.

a. Destination: ATDLY-A to RTS-A.
b. Description: Select RTS - This line specifies either TDIM-A or TDIM-B to be connected to the RTS.

2. Signal - RTS CONN AA.

a. Destination: RTS-A to ATDLY-A.
b. Description: RTS Connection Status- This line reports which TDIM the RTS is connected to.

(c) The following signals are used if RTS-B is on line.

1. Signal - SEL RTS BB.

a. Destination: ATDLY-B to RTS-B.
b. Description: Select RTS - This line specifies either TDIM-A or TDIM-B to be connected to the RTS.

2. Signal - RTS CONN BB.

a. Destination: RTS-B to ATDLY-B
b. Description: RTS Connection Status - This line reports which TDIM the RTS is connected to.

(2) Secondly, the ATDLY receives, from each RTS, the recovered clock signals from the GMs.

(a) A command received from the processor directs the ATDLY which recovered clock to send to the MTGs.
(b) The redundant RTS, ATDLY, and MTG in the TDIGM are configured such that, in case of an MTG switchover, the redundant MTG has the same recovered clock as the original MTG.

1. Signal - REC CLK AA.

   a. Destination: RTS-A to ATDLY-A.
   b. Description: Recovered Clock - This line carries the recovered signal received from the GM.

2. Signal - REC CLK AB

   a. Destination: RTS-A to ATDLY-B
   b. Description: Recovered Clock - This line carries the recovered signal received from the GM.

(c) The following signals are used if RTS-B is on line.

1. Signal - REC CLK BA.

   a. Destination: RTS-B to ATDLY-A.
   b. Description: Recovered Clock - This line carries the recovered signal received from the GM.

2. Signal - REC CLK BB.

   a. Destination: RTS-B to ATDLY-B.
   b. Description: Recovered Clock - This line carries the recovered signal received from the GM.

(3) The RTS/ATDLY/MTG wiring is consistent between TDIMs.

(a) To allow the same recovered clock field in the OFR to be sent to the redundant ATDLY.
(b) To route the same signals to the redundant MTG timing system.

l. GM-to-ATDLY Interface - Provides the processor a path for exchanging information with the GM.

INSTRUCTOR NOTE: Show Slide 20.

(1) The ATDLY issues commands to the GM after receiving an OFR command from the processor.

(a) Signal - TG CMD DAT.

1. Destination: ATDLY to GM.
2. Description: Command Data IN - This line carries 8-bit command data.

(b) Signal - TG CMD DAT EN1.

1. Destination: ATDLY to GM.
2. Description: Command Data In Enable 1 - This line is set active during transmission of the first command to the GM.

(c) Signal - TG CMD EN2.

1. Destination: ATDLY to GM.
2. Description: Command Data In Enable 2 - This line is set active during transmission of the second command to the GM.

(2) The ATDLY collects GM status and transmits this status to the processor when requested.

(a) Signal - GT STAT DAT.

1. Destination: GM to ATDLY.
2. Description: Status Data Out - This line carries 8-bit status data.

(b) Signal - TG STAT EN.

1. Destination: ATDLY to GM.
2. Description: Status Data Out Enable - This line is set active during transmission of the status byte to the ATDLY.

m. TGMOW-to-ATDLY Interface - Provides a path to enable the processor to exchange information with the TGMOW

INSTRUCTOR NOTE: Show Slide 21.

(1) The processor issues an OFR command and the ATDLY provides the control to ensure that the command is issued to the TGMOW.

(a) Signal - TT CMD DAT.

1. Destination: ATDLY to TGMOW.
2. Description: Command Data In - This line carries 8-bit command data.

(b) Signal - TT CMD EN1.

1. Destination: ATDLY to TGMOW.
2. Description: Command Data In Enable 1 - This line is set active during transmission of the first command to the TGMOW.

(c) Signal - TT CMD EN2.

1. Destination: ATDLY to TGMOW.
2. Description: Command Data In Enable 2 - This line is set active during transmission of the second command to the TGMOW.

(d) Signal - TT CMD EN3

1. Destination: ATDLY to TGMOW
2. Description: Command Data In Enable 3 - This line is set active during transmission of the third command to the TGMOW.

(2) The ATDLY also collects status for transmission to the processor when requested.

(a) Signal - TT STAT DAT.

1. Destination: TGMOW to ATDLY.
2. Description: Status Data Out - This line carries 8-bit status data.

(b) Signal - TT STAT EN.

1. Destination: ATDLY to TGMOW.

2. Description: Status Data Out Enable - This line is set active during transmission of the status byte to the ATDLY.

(c) Signal - MAS RESET.

1. Destination: ATDLY to TGMOW.
2. Description: Master Reset - This line provides a master reset of the TGMOW circuit card.

(d) Signal - CARD PRES.

1. Destination: TGMOW to ATDLY.
2. Description: Card Presence Indicator - This line indicates GM and TGMOW card presence.

(e) Signal - R/B SEL.

1. Destination: TGMOW to ATDLY.
2. Description: RED/BLACK Select - This line indicates a RED/BLACK selection status within the TGMOW to the processor.

n. MUX/DEMUX-to-NSYLK Interface - Provides for up to 35 full-duplex TDIGM data channels.

INSTRUCTOR NOTE: Show Slide 22.

(1) The processor selects one of three outputs for each NSYLK card circuit card via ATDLY.

(a) To MUX/DEMUX-A.
(b) To MUX/DEMUX-B.
(c) To the loop modems.

(2) The processor controls the NSYLK outputs in the event of a switchover via ATDLY.
(3) The NSYLK provides level conversion between TTL and TENLEY differential levels when a MUX/DEMUX output is selected.

(4) The number of data channels on this interface is variable, depending on the trunk group size and processor selection of the NSYLK outputs.

(5) Signal - LM TX DATA.

(a) Destination: NSYLK to MUX/DEMUX.
(b) Description: NSYLK Transmit Data channels 1 through 5 TO MUX/DEMUX.

1. There are five data channels whose outputs are processor-controlled between the specified MUX/DEMUX and NSYLK.

2. Each of these lines carries one outgoing 32/16-kb/s data channel.

(6) Signal - ML RX DATA.

(a) Destination: MUX/DEMUX to NSYLK.
(b) Description: NSYLK Receive Data Channels 1 through 5 from MUX/DEMUX. Each of these lines carries one incoming 32/16-kb/s data channel.

o. ATDLY-to-NSYLK Interface - Provides a path for the processor to exchange configuration information with the NSYLK cards.

INSTRUCTOR NOTE: Show Slide 23.

(1) The processor issues an OFR command to the ATDLY card to configure the NSYLK cards.
(2) The ATDLY individually issues commands to the NSYLK to specify the output selection of either:

(a) MUX/DEMUX-A.
(b) MUX/DEMUX-B.
(c) Loop modems.

1. Signal - TL CMD DATA.

a. Destination: ATDLY to NSYLK.
b. Description: Command Data - This line carries 8-bit command data to configure the NSYLK outputs.

2. Signal - TL CMD EN.

a. Destination: ATDLY to NSYLK.
b. Description: Command Data Enable - This signal allows the transfer of command data from the ATDLY to the NSYLK.

(3) The ATDLY collects configuration status from each NSYLK and inserts the status into a block that is transmitted to the processor when requested.

1. Signal - LT STAT DATA.

a. Destination: NSYLK to ATDLY.
b. Description: Status Data - This line carries 8-bit configuration status data.

2. Signal - TL STAT EN.

a. Destination: ATDLY to NSYLK.
b. Description: Status Data Enable - This signal allows the transfer of status data from the NSYLK to the ATDLY.

3. Signal - TL STAT ADD.

a. Destination: ATDLY to NSYLK.
b. Description: Status Addressing (4) - These four lines, when encoded, select one of a maximum fourteen NSYLK cards.
c. The ATDLY uses this addressing when requesting status from an NSYLK card.

INSTRUCTOR NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

5 H

5. AN/TYC-39A Patching.

INSTRUCTOR NOTE: Show Slide 24.

a. The AN/TYC-39A patch panels provide the facility to through-connect, interrupt, or monitor any:

(1) Subscriber.
(2) Trunk.
(3) Modem.
(4) Crypto device.
(5) Line termination unit.

b. This is done on a manual basis.

c. The AN/TYC-39A patch panels provide the facility to substitute or delete circuits or equipment by manual patching.

(1) They provide for manual bypassing of a failed device.

(2) Three levels of patching are provided.

(a) The first level provides for patching subscriber lines to modems or monitoring the Time-Division Interface Group Modified (TDIGM.)
(b) The second level provides for patching of modems and COMSEC equipment.
(c) The third level provides for patching of the Line Termination Units (LTUs) and COMSEC equipment.
(d) All patching jacks are designated as:

1. Line for the input jacks of the patch panel.
2. Equipment for the output jacks.
3. Monitor for the jacks which monitor the input signals.

(e) RED/BLACK isolation is met by physical separation within the shelter.

(3) The CES Group also allows the following communication group equipment to be patched to any of the subscriber cables.

(a) Intercoms.

(b) DSVTs (KY-68.)
(c) DNVTs (TA-838.)

d. Subscriber Input Patch Panel.

(1) The subscriber input patch panel interfaces the subscriber data lines from the Signal Entry Pane (SEP)to the modem nest.
(2) Each panel provides jacks for patching 20 subscribers.
(3) Four normal through-jacks are provided for each subscriber input, each capable of handling a twisted-pair wire interface.
(4) Two monitor jacks are also provided.
(5) There are three subscriber input patch panel assemblies.

(a) 20 subscribers on the first assembly (cables 1 and 2.)
(b) 20 subscribers on the second assembly (cables 3 and 4.)
(c) 8 subscribers on the third assembly (cable 5.)

e. Modem/TDIGM-to-LKG Patch Panel.

(1) The modem/TDIGM-to-LKG patch panel provides a manual patching capability from an LKG output to either a modem or a TDIM.
(2) Patching to a TDIM requires the line to be routed through a processor-controlled LKG Selector (NSYLK card) function.
(3) The NSYLK function must have TDIM selected to perform a TDIM patch.
(4) Six normal-through jacks are provided for patching each of ten Modem/TDIGM-LKG interfaces.
(5) Three monitor jacks are also provided per interface.
(6) There are five Modem/TDIGM-to-LKG patch panel assemblies.
(7) Interface levels are standard LKG levels with a maximum of 3 volts, peak-to-peak.

f. LKG-to-LTU Patch Panel.

(1) The LKG-to-LTU patch panel interfaces the LKG circuits of the TRI-TAC COMSEC equipment to the LTU.

(2) Six normal-through jacks are provided for patching each of 10 LKG - LTU interfaces.
(3) Three monitor jacks are also provided per interface.
(4) There are five LKG-to-LTU patch panel assemblies.
(5) The interface levels are standard LKG levels, with a maximum level of 3 volts, peak-to-peak.

INSTRUCTOR NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

6 H

6. Practical Exercise.

During this practical exercise, evaluate the students ability populate the TDIGM.

a. Explanation to students.

(1) This is a two-part practical exercise. During this practical exercise, you will practice populating the TDIGM nest and answering question on the TDIGM.
(2) Part One. Use the AN/TYC-39A; TM 11-5805-790-12 and 34 series manuals; and populate the TDIGM nest.
(3) Part Two. You must correctly answer 14 out of 20 written questions pertaining to TDIGM in 1 hour.
(4) Perform the procedures that are directed and have your instructor evaluate you as you perform each step.
(5) Remember to be extremely cautious as you handle the components of the power group. High voltages are present in this equipment.
(6) When you are finished with the practical exercise, have your instructor grade it for you.
(7) If what you are required to do is not clear, ask your instructor for clarification.

b. Application by students.

(1) Part One. Using the AN/TYC-39A; TM 11-5805-790-12 and 34 series manuals: The students will populate the TDIGM nest.
(2) Part Two. The students will answer written questions pertaining TDIGM.

c. Evaluation. During Part One of this practical exercise, evaluate each student to ensure they have the ability to populate the TDIGM nest. In Part Two, evaluate each student to ensure they can correctly answer at least 14 out of 20 questions pertaining TDIGM in 1 hour.

17 H 55 M

SUMMARY:

In this lesson, we discussed the AN/TYC-39A Time-Division Interface Group Modified (TDIGM) and its functions. The written performance exercise portion of this lesson enables you to check and reinforce your understanding of the material discussed during this lesson. The practical performance exercise portion of this lesson enables you to apply this information while practicing TTDIGM nest population.

18 H

END

This document Supports Task Number 113-603-3218.

PRACTICAL EXERCISE ANSWER KEY

1.	d	TM 12-6 para 7-9 pg. 7-24
2.	b	TM 12-1 para 1-20 pg. 1-26
3.	d	TM 12-6 para 1-20 pg. 1-26
4.	a	TM 12-5 para 6-43 pg. 6-86
5.	c	TM 12-1 para 1-20 pg. 1-30
6.	d	TM 12-1 para 1-25 pg. 1-25
7.	d	TM 12-1 para F01 pg. FP-1
8.	a	TM 12-1 para F01 pg. FP01
9.	d	TM 12-1 para 1-26 pg. 1-44
10.	d	TM 12-3 para 5-8 pg. 5-15
11.	A23A125, A23A131	TM 12-6 para 7-16 pg. 7-38
12.	TGMOW	TM 12-6 para 7-16 pg. 7-38
13.	Bent Pins	TM 12-6 para 7-16 pg. 7-38
14.	TICAD	TM 12-1 para 1-25 pg. 1-42
15.	HTDM	TM 12-5 para 6-43 pg. 6-86
16.	CIRCUIT SWITCH	TM 12-6 para 7-18 pg. 7-40
17.	NSYLK	TM 12-1 para 1-20 pg. 1-27
18.	DIPULSE, DIPHASE	TM 12-1 para 1-22 pg. 1-32
19.	D	TM 12-1 para 1-20 pg. 1-26
20.	NSYLK	TM 12-6 para 7-16 pg. 7-38

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LESSON PLAN

TITLE: AN/TYC-39A Time Division Interface Group Modified (TDIGM) Fault Isolation and Repair

LEARNING OBJECTIVE:

Action: In Part One, students will isolate and repair faults in the TDIG by running diagnostic tests; replacing faulted components; identifying errors in cable configuration, card strapping, and card population. In Part Two, the students will answer questions about TDIG fault isolation and repair.

Conditions: The student will be given the AN/TYC-39; TM 11-5805-790-12 series; TM 11-5806-790-34 series, and Practical Exercise, 150-74G10/F01-LP04-PE.

Standard: In Part One, acceptable performance is achieved when the student corrects TDIGM faults by running diagnostic tests; replacing components; and identifying errors in cable configuration, card strapping, and card population within 1 hours. In Part Two, acceptable performance is achieved when the student correctly answers 7 out of 10 questions within 1 hour.

SAFETY CONSIDERATIONS: This lesson has safety hazards which may cause electrical shock or physical injury. Make sure students remove all jewelry and metal objects such as watches, rings, bracelets, and identification tags.

RISK ASSESSMENT: LOW.

APPROVAL DATE: DEC 11,1997
DEVELOPER: SSG Shank
DIV. CHIEF: Jack P. Rondon

RESOURCE NEEDS/ REFERENCES: AN/TYC-39; TM 11-5805-790-12 series, TM 11-5805-790-34 Series.

METHODS OF INSTRUCTION: Conference, Practical Exercise

TIME: 13 Hours

NOTES TO INSTRUCTOR:

1. Ensure that all training resources are available.

2. Ensure that all safety procedures and practices are followed.

3. Ensure that equipment is operational before and after class.

INTRODUCTION:

Elapsed Time

1. In the last lesson, you learned about the function and components of the TDIGM.

2. This lesson will focus on TDIGM fault isolation and repair. You will learn how to run diagnostic tests; replace faulted components; and identify errors in cable configuration, card strapping and card population. At the end of the lesson, you will be required to answer 7 out of 10 questions about TDIG fault isolation and repair within 1 hour.

3. Let us begin the lesson by studying the TDIGM fault isolation flowcharts.

3M

NOTE: Inform the students from the beginning of this lesson that their knowledge of digital system installation, learned in the previous lesson, will be broadened into fault isolation in the practical exercise for this lesson.

BODY:

1. Time-division interface module (TDIM) and trunk signaling buffer (TSB) operational printouts.

NOTES: Refer to TM 11-5805-790-12-4, paragraph 5-43, page 5-341.

The TDIM and TSB printouts occur when a fault is indicated in the TDIGM. Many of these printouts contain command, reason, and function codes for fault identification purposes.

a. TDIM and TSB operational printout code descriptions.

(1) Function (func) codes.

These codes indicate a change in function of the TDIG equipment.

(2) Command (cmd) codes.

These codes indicate where the activity of the function is taking place within the TDIG.

(3) Reason (rrrr) codes.

These codes indicate why a printout occurred and what the fault or error was.

b. Examples of TDIM/TSB printouts.

NOTE: Refer students to TM 11-5805-790-12-4, paragraphs 5-43a through 5-43h, pages 5-343 through 5-351. Have the students examine each of the examples as you briefly explain to them why these occur and what they mean.

QUESTION: Which TDIM/TSB operation code indicates a change in the function of the TDIG equipment? (ANS: Function (func) code.)

15M

2. TDIG subsystem fault isolation.

a. When a TDIG fault is indicated you must:

Start at the system fault isolation flow chart which should lead you to TDIGM flow chart para 11-4 page 11-44.Load and run the diagnostic time division interface (DTDI) test.

NOTE: Refer to TM 11-5805-790-12-8, paragraph 11-4, page 11-44 to show the procedures for DTDI.

b. If a diagnose code other than 760000 appears:

(1) You will refer to the TDIG Diagnose Codes and Fault table.

NOTE: Refer to TM 11-5805-790-12-8, paragraph 11-4, pages 11-46 through 11-55.

(2) The diagnose codes listed in table will tell you the card type and card slot of the card to be replaced and tested.

NOTE: Remind the students that the TDIGM card nest is located in A23 . Refer to TM 11 5805-790-12-6, paragraph 7-16, page 7-38 for the TDIGM card rack map.

(3) Replace the TDIGM cards according to the following procedures.

(a) Replace the cards in the order shown on the TDIGM Diagnose Codes and Fault table.
(b) Rerun DTDI after replacing each card.
(c) If the same diagnose code appears, reinstall the original card.
(d) Replace the next card in order and repeat steps (b) and (c) until the code 760000 appears.
(e) If the same code appears after replacing all the cards listed, direct support maintenance procedures will be required.
(f) When the fault is corrected, make the device available by entering the YAVL command.

2. TDIG card cage (A23) removal and replacement.

NOTE: Refer students to TM 11-5805-790-34-1, paragraph 2-32, page 2-25, also Figure 2-16, page 2-29 . Due to the time constraints of this lesson, briefly cover these procedures.

QUESTION: Which TM and paragraph contains the information for TDIG card cage removal and replacement? (ANS: TM 11-5805-790-34-1, paragraph 2-35.)

45M

3. TDIG cable interconnection.

NOTES: Refer students to TM 11-5805-790-34-3, Figure 6-1, pages 6-2 and 6-3 and illustrate the digital signal flow through the components in the CIS. Also refer to TM 11-5805-790-12-6, paragraph 6-40, page 6-126. Briefly reinforce the knowledge of the alternate cable connections, which was covered in the previous lesson. Inform the students that cable replacement may be necessary during direct support/general support (DS/GS) maintenance procedures.

Refer students to TM 11-5805-790-34-4, Table 7-1, page 7-1, for CIS cable assembly information and additional references.

QUESTION: Which TM and figure illustrates the TDIG cable interconnection? (ANS: TM 11-5805-790-34-3, Figure 6-1.)

1H

4. Practical exercise.

a. Explanation to students. This is a two-part practical exercise.

(1) Part One. Use AN/TYC-39; TM 11-5805-683-12 series, TM 11-5805-683-34 series; and Practical Exercise, 150-39G10/J02-LP2-PE, to perform TDIG fault isolation and repair. You will be required to run diagnostic tests; replace faulted components; perform manual resynchronization; and identify errors

in cable configuration, card strapping, and card population. You will have 2 hours to perform these tasks.

(2) Part Two. You must correctly answer 7 out of 10 questions pertaining to TDIG fault isolation and repair within 1 hour.

(3) In Part One, your instructor will evaluate your performance after each individual task has been successfully completed.

(4) In Part Two, have your instructor grade the answers to your questions when you are finished.

(5) If what you are required to do is not clear, ask your instructor for clarification.

b. Application by students.

(1) Part One. Using AN/TYC-39; TM 11-5805-683-12 series, TM 11-5805-683-34 series; and Practical Exercise, 150-39G10/J02-LP2-PE, the students will run diagnostic tests; replace faulted components; perform manual resynchronization; and identify errors in cable configuration, card strapping, and card population.

(2) Part Two. Using TM 11-5805-683-12 series, TM 11-5805-683-34 series; and Practical Exercise, 150-39G10/J02-LP2-PE, the students will answer questions pertaining to TDIG fault isolation and repair.

c. Evaluation. During Part One of the practical exercise, evaluate each student to ensure they have the ability to run diagnostic tests; replace faulted components; perform manual resynchronization; and identify errors in cable configuration, card strapping, and card population. In Part Two, ensure the students can reference the TMs to answer

questions pertaining to TDIG fault isolation and repair.

12H 57M

SUMMARY:

In this lesson, you learned how to run diagnostics; replace faulted components; perform manual resynchronization; and identify errors in cable configuration, card strapping, and card population in the TDIG.

In the next lesson, you will learn the functional analysis of the communications interface group (CIG).

13H

END

This document supports task numbers 113-603-3218 and 113-603-3219.

PRACTICAL EXERCISE ANSWER KEY

1.	DTDI	TM 12-8 para 11-4 pg. 11-44
2.	TGMOW	TM 12-8 para 11-4 pg. 11-47
3.	NSYLK	TM 12-8 para 11-4 pg. 11-53
4.	RUN DCAP	TM 12-8 para 11-4 pg. 11-46
5.	TED/TDIGM (A52)	TM 12-6 para 7-14 pg. 7-31
6.	760000	TM 12-8 para 11-4 pg. 11-46
7.	TED SYNC BAD	TM 12-4 para 5-43 pg. 5-348
8.	NSYLK	TM 12-8 para 11-4 pg. 11-46
9.	DCON/YAVL	TM 12-8 para 11-4 pg. 11-48
10.	MTGSY	TM 12-8 para 11-4 pg. 11-48

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LESSON PLAN

TITLE: AN/TYC-39A Timing System

LEARNING OBJECTIVE:

Action: The student will describe the functions of the timing system in the AN/TYC-39A.

Conditions: Given an operational AN/TYC-39(A), TM 11-5805-790-12 Series, and practical exercise 150-74G10/F01-LP05-PE.

Standard: Acceptable performance is achieved when the student can correctly answer 7 of 10 written questions within 30 minutes.

SAFETY CONSIDERATIONS: There are no safety considerations for this lesson.

RISK ASSESSMENT: LOW.

RESOURCE NEEDS/ REFERENCES: AN/TYC-39(A), TM-11-5805-790-12 series, practical exercise 150-74G10/F01-LP05-PE, overhead projector, and slides 1 through 24

METHODS OF INSTRUCTION: Conference and Practical Exercise

TIME: 6 Hours

NOTES TO INSTRUCTOR:

1. Ensure all training resources are available.
2. Ensure all safety procedures and practices are followed.
3. Ensure all equipment is operational.

APPROVAL DATE: DEC 11,1997
DEVELOPER: SSG Shank
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4. Evaluate students on their ability to perform the learning objective during the practical exercise.

INTRODUCTION:

Elapsed Time

To successfully maintain the AN/TYC-39A, you need a good working knowledge of the AN/TYC-39A timing system. In this lesson, we will study how the AN/TYC-39A timing is generated and all the subassemblies that will distribute and receive the timing.

3M

BODY:

1. Master Timing Generator Overview.

NOTE: Show Slide 1.

a. The MTG provides all the timing reference signal frequencies (also called "clocks" in this course) required by the following subsystems.

(1) Cap/Controller Nest.
(2) Intelligent Line Interfaces (ILIs) of the Communications Interface Group (CIG).
(3) Loop Modems (LMs) of the Common Equipment Support Group (CESG).
(4) Time-Division Interface Group Modified (TDIGM).

b. In a message switch standalone configuration, the MTG internally generates its own frequency standard.

c. When operating with the Digital Transmission Group (DTG), the MTG may be phase-locked to the recovered clock by the TDIGM.

d. The CIG contains two MTGs, which are configurable by the Main Processor (MP) through the CAP.

NOTE: Show Slide 2.

(1) MTG "A".

(a) MTGS4 (nest TDIGM, row 1, slot 22).
(b) MTGSY (nest TDIGM, row 1, slot 20).
(c) LTGA (Red) (nest TDIGM, row 1, slot 11).
(d) LTGA (Black) (nest TDIGM, row 1, slot 5).
(e) MCBM (nest TDIGM, row 1, slot 6).

(2) MTG "B".

(a) MTGS4 (nest TDIGM, row 1, slot 41).
(b) MTGSY (nest TDIGM, row 1, slot 39).
(c) LTGA (Red) (nest TDIGM, row 1, slot 31).
(d) LTGA (Black) (nest TDIGM, row 1, slot 25).
(e) MCBM (nest TDIGM, row 1, slot 26).

(3) The AN/TYC-39A has redundant master timing systems.

(a) Automatic reconfiguration is provided during a failure, as long as the standby timing generator is available.
(b) Reconfiguration can be done via a supervisory command.

NOTE: Explain that the diagram represents only one master timing generator.

(4) MTGS4 Card Functions.

(a) Control and Redundant TDIGM Timing Switch (MTGS4).

1. It provides the switching necessary to select one MTG as the on-line system.
2. The MTGS4 selects the other as the standby timing source.

(b) The MTGS4 contains a Voltage Controlled Crystal Oscillator (VCXO), which provides the clock input to the Frequency Synthesizer (FS).

(c) The MTGS4 also contains built-in test equipment to check the operation of the VCXO and the FS.

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(5) The MTGSY card consists of an FS.

(a) The FS uses the basic clock frequency provided by the VCXO (on the MTGS4 card) to generate the four frequencies required by the LTGA.
(b) These four frequencies are returned to the MTGS4 for distribution to the LTGAs.

(6) Local Timing Generator (LTGA) Black Card Functions.

(a) The LTGA (Black) card receives four input clock frequencies from the MTGS4.
(b) From these clocks, the LTGA derives the clocks required by the TDIGM and by the MCBM card.

(7) Local Timing Generator (LTGA) RED Card Functions.

(a) The LTGA (RED) card receives four input clock frequencies from the MTGS4.
(b) From these clocks, the LTGA derives the clocks required by the TDIGM and by the CAP.

(8) Modem Clock Buffer Monitor (MCBM) Card Functions.

(a) The Modem Clock Buffer (MCB) function provides buffering of the LM clocks generated by the LTG.
(b) The ILI Clock Buffer (ICB) function provides buffering of the 3.072 MHz ILI clock generated by the MTGS4 cards.
(c) The Clock Monitor (CM) function provides the Built-In Test

Equipment (BITE) for performing checks of the timing system.

NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

1H

2. Timing System Alarm and Selection.

NOTE: Show Slide 3.

a. The MTG is dual-redundant, with one unit on-line and the other used as a standby.

(1) The capability to switch either MTG on-line or off-line is provided within the dual-redundant MTGs.
(2) An MTG switchover is initiated by the on-line MP via a command to the CAP.

b. Timing System Switchover.

(1) An MTG is brought on-line/off-line by selection from the MP through the CAP or by automatic switchover.
(2) MP through the CAP MTG Switchover.

(a) To switch over, the CAP asserts or does not assert a select line that selects either MTG A or MTG B.
(b) If the MTG determines that it cannot make the requested MTG on-line, it overrides the MP's request, puts the appropriate MTG on line, and indicates the actual on-line device through the status line to the CAP.

(3) Automatic MTG Switchover.

(a) In the case of automatic switchover, a fatal condition has been detected by the MTGs, requiring immediate action to maintain an on-line timing system.
(b) When this occurs, the CAP is alerted to the status change by the

Select function, through its status lines A and B.

(c) The CAP then passes this change to the MP.

(d) While this condition exists, Select A ignores the MP request to bring the failed MTG on-line.

(e) Automatic switchover occurs under the following conditions.

1. On-line MTGS4 is physically removed or is unable to report its status on the MTGS4 status line.
2. On-line MCB card (Select, CM, ICB, MCB functions) is physically removed.
3. CM of on-line MTG detects a fault in the 1.152 MHz in-phase or out-phase clock to the CAP.
4. CM of on-line MTG detects a self-test failure.

(f) Both MTGs may not be on-line at the same time.

c. Select Function.

(1) The Select function provides the ability to:

(a) Bring an MTG on-line, enable the output of its clocks to the system.

(b) Bring an MTG off-line and disable the output of its clocks to the system.

(2) MP Timing System Selection.

(a) The MP selects the on-line timing system based on information it receives in the ITR status word.

(b) If the MP selects MTG A:

1. The CAP sends a signal to the select A line to enable MTG A.

2. Select A reads this select request and determines whether it can bring MTG A on-line by reading the status lines from MTGS4 A and B, interrogating Select B, and checking its own status.
3. If Select A determines conditions are favorable, it enables MTGS4 A, which in turn disables MTGS4 B.
4. The MTGS4 status lines, indicating MTGS4 A enabled and MTGS4 B disabled, are read by both Select A and B.
5. Select A and B update the status A and B lines to reflect the current configuration.

(c) If the MP selects MTG B:

1. The CAP sends a signal to the select A line to enable MTG B.
2. Select A reads this select request and determines whether MTG B can come on-line by reading the status lines from MTGS4 A and B and interrogating Select B.
3. If Select A determines conditions are favorable, it disables MTGS4 A, which in turn enables MTGS4 B.
4. The MTGS4 status lines, indicating MTGS4 B enabled and MTGS4 A disabled, are read by both Select A and B.
5. Select A and B update the status A and B lines to reflect the current configuration.

(3) Select Function Interfaces.

(a) Select to CAP.

1. The Select-to-CAP interface is different for the two MTGs.
2. The Select A function-to-CAP interface consists of a Select A line which is driven by the CAP and indicates the MP's preference for the on-line timing system, MTG A or B.

    a. If the select line is 1, MTG A has been selected by the MP.
    b. If the select line is 0, MTG B has been selected.

3. The Select A function has a Status A line from Select A to the CAP to indicate which MTG is on-line.

    a. Status A=0, B=1 is MTG A on-line.
    b. Status A=1, B=0 is MTG B on-line.
    c. Status A=0, B=0 or A=1, B=1 is invalid.

4. The Select B function-to-CAP interface consists of a status B line which also indicates the current on-line MTG.

(b) Select to MTGS4.

1. The Select-to-MTGS4 function is different for the two MTGs.
2. The Select A-to-MTGS4 interface consists of an MTGS4 A select line which is used to enable/disable MTGS4 A, i.e., bring MTG A on-line/off-line.
3. It also has an MTGS4 A status line and an MTGS4 B status line which indicates whether MTGS4 A or MTGS4 B has been selected.

4. The Select B-to-MTGS4 interface consists of an MTGS4 A status line and an MTGS4 B status line.
5. MTGS4 A provides the enable/disable select line to MTGS4 B.
6. When MTGS4 A is selected, MTGS4 B is disabled and vice-versa.

(c) Select A to Select B - Serial status lines are provided between the select functions of MTG A and MTG B to communicate configuration status and initiate switchovers.

d. Control and Redundant TDIGM Timing Switch (MTGS4).

(1) The MTGS4 provides an interface to the Select function.
(2) For MTG A, this interface consists of an MTGS4 A Select line and MTGS4 A Status line.
(3) For MTG B, the interface to the Select function consists of an MTGS4 B Status line.
(4) The MTGS4 contains Built-In-Test Equipment to check the operation of the VCXO and the FS and report its status.
(5) The MTGS4 function collects the LTG A and LTG B fault status indicators.
(6) The MTGS4 enables the RED and Black LTG associated with its MTG and provides them with clocks.

NOTES: Refer students to Information Sheet E2-1, MTG Switchover State Diagram, and discuss.

Recapitulate key points. Ask questions to ensure student understanding of material covered.

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3. Clock Monitor (CM).

NOTES: Show Slide 4.

The information on the CM provided in this lesson plan may be more detailed than necessary for some students.

a. Overview - Each MTG contains a CM which periodically checks the frequency of the various clocks generated by the MTG and distributed to the ILIs, the TDIGM, the LMs, and the CAP.

(1) The CM is part of the MCBM card.
(2) The CM sets bits in a status register of its control function when it detects a clock that is not operating within specified frequency limits.
(3) The CAP periodically reads this 32 bit ITR status word from each CM and makes it available to each MP.
(4) The ITR status word identifies the distribution point where the failure was detected.
(5) The CM associated with the on-line MTG monitors those signals generated by its own MTG.
(6) The CM associated with the off-line MTG continuously runs a self-test.

b. Summary Faults - The CM receives summary status faults from the Built-In-Test Equipment in the MTGS4 function.

(1) The summary status faults are hardwired in the ITR status register.
(2) When the CM detects a clock that is not operating within specified frequency limits, it sets the associated bit or bits in its ITR status word.
(3) This ITR status word is read by the CAP and then by the on-line MP.
(4) The CM provides an ITR status word to the MPs which identifies the distribution point where the failure was detected.
(5) The CM receives OFR command words from the MP via the CAP.
(6) The CM can also perform a test on itself, both periodically and if

commanded by the MP via an OFR command word.

c. Functional Description - The CM is made up of the following functional blocks.

(1) Clock frequency monitor.
(2) MTG summary status collector.
(3) Control Function.

(a) Clock Frequency Monitor - Selected MTG frequencies are transmitted to the clock frequency monitor to be checked for operation within specified frequency limits.

1. These clocks are required to operate with a tolerance within 5 percent of their specified frequency.
2. The clock frequency monitor is capable of inducing a fault upon command from the Control function.
3. The following categories of frequencies are checked by the CM.

a. The lowest frequency in each group of RED and Black LTG clocks (to the TDIGM).
b. The LM clocks (from the LTG Black as inputs to the MCB).
c. The LM clocks to each LM nest row (output from MCB).
d. The 3.072 MHz clock (from the MTGS4 as an input to the ICB).
e. The ICB output 3.072 MHz clock to each ILI group (from ICB).
f. The 1.152 MHz in and out phase clocks to the CAP (from RED LTG).

(b) Clock Frequency Monitor Test - The clock frequency monitor sequentially checks the frequencies of the clocks generated by the LTG RED, LTG Black, MCB, ICB, and MTGS4 functions.

1. The clock frequency monitor scans through the assigned MTG frequencies, counting each frequency and comparing that count to a count stored within the clock frequency monitor.

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2. The clock frequency monitor is capable of monitoring the MTG clocks strapped at either the 32 kb/s or 16 kb/s rate, as commanded by the Control function.

3. The clock frequency monitor does not monitor clocks until commanded to by the Control function.
4. It then monitors continuously until all clocks have been checked, making status available to the Control function at the end of each clock frequency monitor cycle.
5. The clock frequency monitor continues to monitor all clocks, whether it discovers a fault or not.
6. Test Description.

    a. LTG RED output clocks test (strapped at 32 kb/s or 16 kb/s).
    b. LTG Black output clocks test (strapped at 32 kb/s or 16 kb/s).
    c. Modem source clocks test (output from LTG Black and input to MCB).

d. Modem nest row 1 clocks test (output from MCB).
e. Modem nest row 2 clocks test (output from MCB).
f. Modem nest row 3 clocks test (output from MCB).
g. Modem nest row 4 clocks test (output from MCB).
h. ILI source clocks test (output from MTGS4 and input to ICB).
i. ILI group 1 clocks test (output from ICB).
j. ILI group 2 clocks test (output from ICB).
k. ILI group 3 clocks test (output from ICB).
l. ILI group 4 clocks test (output from ICB).
m. ILI group 5 clocks test (output from ICB).

(c) LTG RED and LTG Black Output Clocks Test - The clock frequency monitor checks several selected LTG frequencies from the RED LTG and the black LTG.

1. The clock frequency monitor checks the LTG clocks to an accuracy of 5 percent.
2. The following frequencies are checked by the CM clock frequency monitor.

Strapped at 32 Kilobits	Strapped at 16 Kilobits
a. 1.152 MHz	a. 576 kHz
b. 288 kHz	b. 144 kHz
c. 42.2268 kHz	c. 42.2268 kHz
d. 39.3846 kHz	d. 39.3846 kHz
e. 38.4 kHz	e. 38.4 kHz
f. 32 kHz	f. 16 kHz

g. 2 kHz

h. 1.152 MHz in-phase

i. 1.152 MHz out-phase

g. 1 kHz

h. 1.152 MHz in-phase

i. 1.152 MHz out-phase

(d) MCB Clock Tests - The clock frequency monitor checks all the LM frequencies, both at the input to the MCB and at the output of the MCB.

1. On input, the MCB receives six clocks from the Black LTG.
2. On output, the MCB delivers the six clocks to four nest rows.
3. The clock frequency monitor checks the LM clocks to an accuracy of 5 percent.
4. The following frequencies are checked by the CM clock frequency monitor.

a. 1.152 MHz.
b. 512 kHz.
c. 153.6 kHz.
d. 42.2268 kHz.
e. 39.384 kHz.
f. 38.4 kHz.

(e) ICB Clock Tests - The clock frequency monitor checks the ILI frequency both at the input to the ICB and at the outputs of the ICB.

1. On input, the ICB receives a 3.072 MHz clock from the MTGS4 function.
2. On output, the ICB delivers the clock to five ILI groups.
3. The clock frequency monitor checks the ILI clock to an accuracy of 5 percent.
4. The 3.072 MHz clock is the only clock frequency sent to

the ILI and checked by the clock frequency monitor.

(4) MTG Summary Status Collector - The MTGS4 card issues a four bit status report to the MTG summary status collector.

(a) The summary status report consists of information received from the BITE in the MTGS4 and from the BITE in the LTGs.
(b) This report contains four bits that identify faults occurring in:

1. VCXO synchronization.
2. FSs synchronization.
3. The operation of the LTGs RED and Black.

(c) The MTG summary status collector provides this status directly to the ITR status register.
(d) The following status is reported by the MTG summary status collector.

1. VCXO loss of synchronization.
2. FS-A loss of synchronization.
3. LTG RED fault.
4. LTG Black fault.

(5) Control Function - The Control function receives commands from the CAP and makes status available to the CAP.

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(a) It receives commands from the CAP in the form of OFR command words which originate at the MP. These OFR command words are 32 bits in length, with only certain bits defined.
(b) The Control function maintains an ITR status word register for retrieval by the CAP.

1. This register is 32 bits in length and contains CM and MTG status.

2. After the CAP has read the ITR status word, it stores the ITR status word in a CAP ITR register.
3. The CAP ITR register is available for the MP to read.

(c) The Control function controls the clock frequency monitor functions.
(d) The Control function has a reset or initial state as defined below.

1. Control function idle.
2. Clock frequency monitor idle.
3. Clock frequency monitor is set to monitor clocks at 32 kb/s.
4. ITR status register reads all zeros except for bits 8-11, bit 31, and the address bits for CM A or CM B.

(e) The Control function goes to this reset or initial state under the following conditions.

1. After power-up.
2. When its CAP reset line is asserted.

d. Control Function Sequence or CM Cycle.

(1) The CM cycle is executed by the Control function associated with the on-line MTG.
(2) The Control function associated with the off-line MTG continuously performs only those steps in the CM cycle necessary to initiate and report the self-test.
(3) The CM cycle lasts a maximum of 10 seconds.

(a) When a new cycle is complete, the Control function overwrites the old ITR status word.
(b) The CAP may read the ITR status word at any time during the CM cycle.

(c) The CAP may issue an OFR to the CM any time during the CM cycle.
(d) An OFR received by the CM during the clock frequency monitor cycle causes the CM to stop its cycle, processes the OFR, updates the ITR status word (self-test and strapping status), and restarts the CM cycle at the beginning.
(e) An OFR received after the clock frequency monitor cycle is serviced after the completion of the CM cycle.

(4) The CM Cycle.

(a) Command the clock frequency monitor to monitor clocks strapped at 32 kb/s or 16 kb/s.
(b) Command the clock frequency monitor to begin its cycle.
(c) Wait for a cycle complete indication from the clock frequency monitor (eight seconds maximum).
(d) Read the clock frequency monitor status.
(e) Initiate CM self-test.
(f) Wait for CM self-test to complete.
(g) Read the self-test status.
(h) Update the ITR status word (indicate a CM failure if the timer of step c expires.)
(i) Return to step a (step e if off-line).

e. Self-Test.

(1) The Control function initiates a self-test as part of its CM cycle and upon MP request in bit 5 of the OFR.
(2) The self-test performed is the same regardless of the initiator.
(3) Results of self-tests are reported in bits 4 and 5 of the ITR status word.
(4) As part of its self-test, the clock frequency monitor induces a faulted clock frequency into one of its interface functions.

(5) The faulted frequency is used to verify the proper operation of the clock frequency monitor.
(6) The self-test consists of the following subtests.

(a) 12 MHz reference clock check.
(b) Induced clock fault.
(c) Timer check.
(d) Clock Multiplexer check (p/o clock frequency monitor).
(e) Counter check.

3H 10M

4. MTG Recovered Clock.

NOTES: Show Slide 5.

Refer students to Information Sheet E2-3, AN/TYC-39A MTG Recovered Clock Timing Generation Block Diagram Foldout, and go over the recovered clock with the students.

a. Overview.

(1) In a Message Switch standalone configuration, the MTG internally generates its own frequency standard.
(2) When operating with the DTG, the MTG is phase locked to the clock recovered by the group modems.

b. Recovered clock may be recovered from either DTG A or DTG B.

(1) Receive data enters the Remote Transfer Switch from the DTG cable via the Signal Entry Panel (SEP).
(2) Under processor control, the Remote Transfer Switch (RTS) provides the switching to connect the on-line group modem to the circuit switch.
(3) Receive data is then sent to the on-line TDIGMs group modem.
(4) The on-line group modem takes the receive data and develops recovered clock from it.

(a) This recovered clock is then sent back out to the RTS.
(b) If the group modem cannot develop a clock from the receive data, then a loss of clock alarm is sent to the RTS.

(5) The RTS also switches the recovered clock and recovered clock alarm to the TICAD.
(6) The ATLDY then sends either recovered clock or loss of clock alarm to the MTGS4 card.

NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

3H 30M

5. MTG Clock Generation and Distribution.

NOTES: Show Slides 6 and 7.

Refer students to Information Sheet E2-3 and go over the MTGS4 and MTGSY cards with the students.

a. VCXO Frequency - The VCXO (on the MTGS4 card) provides a 12.288 MHz output frequency.

(1) In the standalone mode, it has a stability of plus or minus 25 parts per million on top of a long-term drift of plus or minus 10 parts per million per year when the system is fully operational within the temperature range of -21° F to +185° F.
(2) In the phase-locked mode, it has the stability of the incoming DTG.
(3) The MTGS4 provides the 3.072 MHz clock to the ICB from one of the clock signals provided by the FS.

b. Frequency Synthesizer (FS).

(1) The FS uses the 12.288 MHz clock provided by the VCXO to generate four frequencies required by the LTG.

(2) These four frequencies, which are returned to the MTGS4 for distribution to the LTGs, are as follows.

(a) 18.432 Mhz.
(b) 16.384 Mhz.
(c) 12.288 Mhz.
(d) 100 Hz.

c. Modem Clock Buffer (MCB) (part of MCBM card).

(1) The MCB provides buffering of the LM clocks generated by the LTG.
(2) The MCB supplies an identical set of six buffered clocks to each nest row of LMs.
(3) The frequencies provided by the MCB to the LMs are as follows.

(a) 1.152 Mhz.
(b) 512 kHz.
(c) 153.6 kHz.
(d) 42.2268 kHz.
(e) 39.3846 kHz.
(f) 38.4 kHz.

d. ILI Clock Buffer (ICB).

(1) The ICB provides buffering of the 3.072 MHz ILI clock generated by the MTGS4.
(2) The ICB supplies an identical 3.072 MHz clock to each group of ILIs.
(3) There are five groups of ILIs with no group containing more than three ILIs.

e. Local Timing Generator (LTG).

(1) The LTG receives four input clock frequencies from the MTGS4. From these clocks, the LTG derives the clocks required by the TDIGM, the MCB, and the CAP.
(2) Each MTG contains one RED LTG and one Black LTG.
(3) The RED LTG provides 15 frequencies to the TDIGM and 2 frequencies to the CAP.

(4) The Black LTG provides six frequencies to the TDIGM and six frequencies to the LMs via the MCB.
(5) Each LTG contains BITE to check its operation.
(6) This test equipment issues status reports to the MTGS4 function, which forwards the status to the CM.
(7) The clocks produced by the LTG are synchronized with the 100 Hz clock from the FS.
(8) RED LTG to TDIGM - The RED LTG provides the following frequencies to the TDIGM equipment. (* These frequencies are for 32 kb/s operation. For 16 kb/s operation, the LTG divides these frequencies by two. *)

(a) 1.152 MHz In-Phase.
(b) 1.152 MHz Out-Phase.
(c) 256 kHz.
(d) 100 Hz Ext. Sync Pulse.
(e) 4.608 Mhz.
(f) *2-kHz 1/2 Frame Rate.
(g) 16-kHz Frame Rate.
(h) 4.096 Mhz.
(i) 16-kHz Loop Rate.
(j) *32-kHz Loop Rate.
(k) *32-kHz Frame Rate.
(l) *4-kHz Frame Rate.
(m) 4 kHz.
(n) 2.304 Mhz.
(o) 3.072 MHz.

(9) RED LTG to CAP - The black LTG provides the following clock frequencies to the TDIGM.

(a) 1.152 MHz In-Phase
(b) 1.152 MHz Out-Phase

(10) Black LTG to LMs - The black LTG provides the following frequencies to the MCB to be buffered and distributed to the LMs.

(a) 1.152 Mhz
(b) 512 kHz

(c) 153.6 kHz
(d) 42.2268 kHz
(e) 39.3846 kHz
(f) 38.4 kHz

(11) Black LTG to TDIGM - The black LTG provides the following clock frequencies to the TDIGM.

(a) 4.608 Mhz
(b) 4.096 Mhz
(c) 100 Ext Sync Pulse
(d) 3.072 Mhz
(e) 512 kHz
(f) 32 kHz

NOTE: Recapitulate key points. Ask questions to ensure student understanding of material covered.

4H

6. Master Timing Generator Interfaces.

a. Modem Timing.

NOTE: Show Slide 8.

(1) The MCB receives several input clocks from the (Black) LTGA and buffers them for the LM nests.
(2) The MTG supplies an identical set of buffered clocks to each LM nest row.

NOTE: Show Slide 9.

(3) All six clocks used by the modems are provided from MTG A and MTG B.

(a) It should be noted that the outputs of the MCBM A and B card are wired together but are independent of each row.
(b) Modem timing problems that are not related to a specific modem card may show up throughout the modem row for all modems using a specific clock.

(4) From the Black LTG to the MCBM to each modem as follows:

(a) Row 1 modems 1-12
(b) Row 2 modems 13-24
(c) Row 3 modems 25-36
(d) Row 1 modems 37-48

(5) Diphase Modems require two clocks.

NOTE: Show Slide 10.

(a) 512 kHz
(b) 153.6 kHz (for 9.6k, 4.8k, 2.4k, 1.2k)

(6) Type II Modems require one clock: 1152 kHz

NOTE: Show Slide 11.

(a) The MOD 21 card receives the clock from the MCBM card.
(b) The MOD 22 card receives the clock from the MOD 21 card.
(c) Test point 18 on the MOD 21 card = 1152 kHz.

(7) Type I Modems require four clocks.

NOTE: Show Slide 12.

(a) 512 kHz
(b) 39.3 kHz - This clock is used by the Type I modem to develop the 1230.76875 Hz FSK frequency (SPACE frequency). This clock is on test point 4 of type 1 modem.
(c) 42.2 kHz - This clock is used by the Type I modem to develop the 1319.5875 Hz FSK frequency (MARK frequency). This clock is on test point 2 of type 1 modem.

4H 20M

(d) 38.4 kHz - This clock is used by the Type I modem when interfacing with a Dedicated Loop Encryption

Device (DLED) operating at one of the following data rates.

1. 150 baud
2. 75 baud
3. 50 baud

b. ILI Timing.

NOTES: Show Transparencies 13 and 14.

Refer students to Information Sheet E2-4, ILI Timing, and explain the card and pin out flow of the ILI input clock.

(1) A 3.072 MHz clock is distributed to each ILI group.

(a) ILI 1 - 3 = Group 1
(b) ILI 4 - 6 = Group 2
(c) ILI 7 - 9 = Group 3
(d) ILI 10 - 12 = Group 4
(e) ILI 13 = Group 5

(2) The 3.072 MHz clock signal line is a square wave.
(3) MCBM B and MCBM A have a clock line for each ILI group.
(4) This 3.072 MHz clock is only used by the ILI to generate the LTU clocks.
(5) The ILI in turn generates all clocks required by the LTUs.

(a) The ILI uses an LTU clock generator to produce the following clocks.

1. 76.8 kHz
2. 4.755 kHz
3. 3.64 kHz
4. 3.2 kHz
5. 2.909 kHz
6. 32 kHz

(b) The DLTM 6 and 9 cards are provide with all six clocks via nest wiring.

1. The DLTM6 card utilizes all six clocks
2. The DLTM9 card only utilizes the 76.8 kHz and 32 kHz clocks.

(c) The DLTM8 card is provided with the 32 kHz clock.
(d) LTUs associated with the a specific ILI receive clocks from that ILI

5H

c. MTG-to-CAP Timing.

NOTE: Show Slide 15.

(1) The MTG-to-CAP interface is made up of three separate interfaces.

(a) The clock.
(b) The configuration.
(c) The CM.

(2) The LTGA (RED) card of the MTG sends two timing signals out to the CAP.

(a) 1.152 MHz in-phase.
(b) 1.152 MHz out-of-phase.
(c) The two clocks are out of phase with each other and provide the CAP with timing signals necessary to transmit and receive signals from the ALTDY card and from the MTG CM.
(d) These two signals are provided to "CAPA" card in the controller nest.

1. The CAPA card distributes the two clocks to the CAPB cards.
2. Test Point (TP) 47 on the CAPB cards is 1.152 MHz in-phase.

(e) The 1.152 MHz clocks are also used for internal timing in the CAPA cards.

NOTE: Show Slide 16.

(3) The CAPB card has an oscillator (Y1) that generates a 12.288 MHz clock.

(a) Only the CAPB card in slot XA114 is wired to use this oscillator.
(b) This 12.288 MHz clock provides timing to the three VTTYC cards that control the VDTs.
(c) This 12.288 MHz clock is independent of the MTG clocks.

d. TDIGM Timing.

NOTE: Show Slide 17.

(1) The MTG-to-TDIGM interface is the means by which the TDIGM equipment are supplied with timing signals.
(2) These timing signals come from either MTG A or MTG B.
(3) All clocks required for the Group Modem (GM) are provided by either the RED or Black Local Timing Generator (LTG) through the GCLK function of the Transmission Group Module Orderwire (TGMOW).

(a) 4.608 Mhz.
(b) 4.096 Mhz.
(c) 100 Hz.

(4) The MTG provides clocks from both the Black LTG and RED LTG for the TGMOW.

(a) 4.608 MHz (black).
(b) 4.096 MHz (black).
(c) 100 Hz (black).
(d) 4.608 MHz (RED).
(e) 4.096 MHz (RED).
(f) 100 Hz (RED).
(g) 32 kHz (RED).
(h) 16 kHz loop (RED).
(i) 16 kHz frame (RED).

(5) The RED LTG provides clocks directly and indirectly to the MUX/DEMUX.

(a) 4.608 MHz (RED).

(b) 16 kHz loop (RED).
(c) 4 kHz frame (RED).
(d) 2 kHz 1/2-frame (RED).

(6) The group rate clocks for the MUX/DEMUX are supplied by the group modem.
(7) The clocks for ATLDY are supplied by the RED LTG.

(a) 100 Hz (RED).
(b) 1.152 MHz (RED).
(c) 576 kHz (RED).
(d) 288 kHz (RED).
(e) 1024 kHz (RED).
(f) 512 kHz (RED).
(g) 256 kHz (RED).
(h) 32 kHz loop (RED).
(i) 1.152 MHz in phase (RED).
(j) 1.152 MHz out phase (RED).

(8) The clocks for TSB are supplied by the RED LTG.

(a) 32 kHz loop (RED).
(b) 1.152 MHz in-phase (RED).
(c) 1.152 MHz out-phase (RED).

(9) The clocks for SBC are supplied by the RED LTG.

(a) 1.152 MHz in-phase (RED).
(b) 1.152 MHz out-phase (RED).

5H 30M

NOTE: Refer students to Information Sheet E2-5, MTG Block Diagram Foldout, and discuss. Review material covered in this lesson.

5. Practical exercise.

a. Explanation to students.

(1) You must correctly answer 7 out of 10 questions on the practical exercise by filling in the blank or circling the correct answer on the multiple choice questions.

(2) When you are finished with the practical exercise, have your instructor grade it for you.
(3) If what you are required to do is not clear, ask your instructor for clarification.

b. Application by students.

(1) You must correctly answer 7 out of 10 questions on the practical exercise by filling in the blank or circling the correct answer on the multiple choice questions in 30 minutes.
(2) When you are finished with the practical exercise, have your instructor grade it for you.
(3) If what you are required to do is not clear, ask your instructor for clarification.

c. Evaluation. During this practical exercise evaluate each student to ensure they can correctly answer at least 7 out of 10 questions pertaining to the timing system within 30 minutes.

5H 55M

SUMMARY:

In this lesson, we discussed the AN/TYC-39A timing system. The written performance exercise portion of this lesson will enable you to check and reinforce your understanding of the material discussed during this lesson.

6H

END

This document supports Task Number 113-603-3216, 113-603-3218 and 113-603-3219.

PERFORMANCE EXERCISE ANSWER KEY

1. Where would you find the MTGS4 card for MTG A? (Give nest, row, and slot number.)

   NEST TDIGM (A23), ROW 1, SLOT 22

2. What does the MTGSY card consist of (main item) and what is its function?

   CONSISTS OF THE FREQUENCY SYNTHESIZER. IT'S FUNCTION IS TO GENERATE FOUR FREQUENCIES.

3. What frequencies are used by the diphase loop modem?

   153.6 kHz, 512 kHz

4. What frequency is sent to the CAP from the MTG?

   1.152 MHz

5. What card contains the Clock Monitor Unit (CMU)?

   MODEM CLOCK BUFFER MONITOR (MCBM)

6. What is the frequency sent to the MTGSY from the MTGS4?

   12.288 MHz

7. Where does an LTU get its timing from?

   ILI CARD (LTU TIMING GENERATOR)

8. Where do the VDT controllers get their timing from?

   CAPB B CARD XA114 (Y1 OSCILLATOR)

9. To what units does the MCBM card supply clocks?

   ILIs AND MODEMS

10. What clock does a Type II modem require?

    1152 kHz